AN EVALUATION OF A GENETIC SCREENING PROGRAM FOR THALASSEMIA TRAIT IN A GREEK ADOLESCENT POPULATION

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CHAPTER 1

Introduction

Considerable controversy exists concerning appropriate target populations for mass genetic screening and counseling.[1] The optimal age for screening in many cases depends on the aim of the test. Programs geared toward identifying homozygous recessive diseases such as sickle cell anemia and phenylketonuria have screened infants primarily for the purpose of initiating treatment. Screening programs designed to identify the heterozygous carrier state have traditionally been aimed at young children in sickle cell trait and married couples for a variety of other disorders such as Tay-Sachs and Duchenne Muscular Dystrophy.

Although few would argue with screening of newborns and infants to detect treatable diseases, many questions arise as to the benefits of screening young children for carrier states. Fost suggests that one major advantage of screening any individual for a heterozygous condition would be to offer genetic counseling for family planning.[2] But, in discussing sickle cell trait in particular, he states: "it is not clear that many of the programs currently under way make such use of the information derived from screening children." It is not possible to provide meaningful and helpful genetic counseling at such a young age. Others have justified the screening of young children for sickle trait

by citing sickle cell trait as causative of a number of medical complications requiring parental education.[3-6] Pearson, however, feels that a true causal relationship has been established for so few pathologic entities that sickle cell trait "should be considered a benign inherited anomaly and not a pathologic state."[7]

If one accepts this premise, the sole aim of identifying these children is to provide information helpful to making informed decisions concerning marriage and family planning. In this regard screening programs for young children do not seem particularly useful.

To provide reproductive information to the reproducing population has been the aim of several screening and education programs. Kaback, in his model educational testing program for Tay-Sachs, carefully selected only young married couples to participate.[8] He purposefully excluded single persons from his testing, suggesting that there is "no incentive for a single person to know his genotype."[9] Other adult screening programs have been less selective. Ivker's Tay-Sachs screening program in Louisiana tested 475 volunteers, 44% of whom were post-reproductive.[10] One must certainly argue with the cost effectiveness of screening post-reproductive individuals.

More commonly, adults have been screened for recessive traits only following the birth of affected children.[11] If the goal of genetic screening is to provide useful genetic information to assist in family planning, these screening

programs are clearly too late. Of 53 women counseled for Duchenne Muscular Dystrophy in Edinburgh by Emery, four women were pregnant at the time of counseling. Obviously, for effective prevention, these programs must provide information to people prior to pregnancy. Furthermore, autosomal recessive disease occurs principally in families where it has not been known before. In Tay-Sachs disease 82% of the cases marked the first appearance of the condition on either side of the family.[12] Thus, if one waits for a proband case to occur, only about 20% of the total cases are preventable. In order to detect the majority of cases prenatally, it is necessary to identify at-risk matings before they reproduce.

In this regard, screening of adolescents would appear to offer a number of advantages.[13] Although they are approaching the age when marriage and family planning are particularly relevant, they are generally unmarried. A screening program offered at this time would allow the maximum freedom of choice for carriers with respect to both mate selection and reproductive planning. In addition, since a large part of any screening program must be educational, an appropriate population must be selected for which the information can be meaningful. Adolescence is a particularly advantageous time for introduction of information pertinent to self concept and future plans, as it is during this time that individuals begin to become more responsible for them-

selves and more self aware. Information introduced at this time might be maximally integrated.

And, practically, school attendance by most adolescents makes them readily available for testing and permits education at a time when pertinent concepts are being learned. It is during this period of education that young people are initially introduced to courses on genetics and human biology that provide a necessary framework for understanding a disease carrier state and genetic risks.

In a study of compliance* among those tested for Tay-Sachs in Montreal, Beck et al. found the highest compliance among high school students.[14] And when the school physician recommended testing to students in an official letter to all Jewish students, participation rose from 27.6% to 61.5%-100% of the school populations. The second most compliant group was college students with the third being newlyweds. Thus, both in terms of availability and interest, the adolescent population might be particularly appropriate for mass voluntary educational testing programs.

In this light, it is somewhat remarkable that so few educational testing programs have been designed solely for the adolescent. The only published account of such a program describes the education, screening, and counseling of 16,418 Job Corps members, ages 16 to 21, for sickle cell

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*compliance = $1 - \frac{\#\text{no shows}}{\text{total}}$

trait.[15] The impetus for such a program was the apparent widespread interest and concern amongst the corpsmembers as to whether or not they had "sickle cell" and what, in fact, it was. Most demonstrated a profound lack of understanding of the disease and trait. Few understood genetic transmission or risks. Many felt that sickle cell trait and anemia were fictitious conditions fabricated by white supremacists to keep blacks subjugated. In short, this educational program was hardly organized in time to prevent such rampant misinformation.

In many ways this educational testing program was unique, eliminating many problems of previous mass screenings. Written informational materials were tailored to the specific needs and backgrounds of the "economically disadvantaged" adolescents. Courses and counseling were conducted by specially trained staff members of the Job Corps program followed by voluntary screening. Individual counseling accompanied all positive screening reports. And, finally, nondirective reproductive options were discussed. Despite these appealing features, this program has the deficiency of so many others like it--no follow-up evaluation was made to determine its effectiveness in disseminating information. And no assessment was made of the program's emotional impact, a particularly important feature in view of the large number of people involved.

In order that some of these issues might be further

studied, Pearson et al. conducted a state-wide educational screening program for thalassemia trait in a Greek population.[13,16-17] Although the educational program and screening was open to any interested person affiliated with the three Greek Orthodox churches in Connecticut, particular encouragement was given to high school aged people, and the educational program was designed to suit the unique needs of the adolescent age-group. Similar to the sickle cell trait screening program for adolescents, Pearson's program included individually tailored written information, an educational program organized with members of the Greek Orthodox church, voluntary testing, and individual counseling accompanying all positive test results. In addition a non-directive, non-coercive approach was taken in presenting reproductive options for these adolescents. However, unlike the sickle cell program, the easy availability of all participants in the thalassemia testing program has made follow-up possible.

It is the purpose of this study, therefore, to critically appraise the adolescent response to genetic screening and to evaluate those issues which have never been adequately studied in this most interesting age group. Specifically:

1) How well does the adolescent comprehend the factual information about thalassemia trait and thalassemia major that is presented to him or her?
2) How well does the adolescent incorporate his/her knowledge into reproductive attitudes?

3) What emotional impact does carrying the trait for a lethal disease have on the adolescent?

Thus an attempt will be made to assess both the positive and negative impact of this program on adolescents. Recommendations will also be made as to how programs such as this might be improved in the future, should they prove to be more advantageous than harmful.

Thalassemia

The thalassemias are autosomal recessive hemoglobinopathies occurring in ethnic groups which can be traced to the Mediterranean Sea, Middle East, and Southeast Asia.[18] In this country they are found to affect people of Greek, Italian, and North African ancestry with the greatest frequency. The genetic defect in thalassemia results in the deficient synthesis of one of the polypeptide chains of hemoglobin. The homozygous state presents in two forms: α thalassemia major (defect in the α chain of hemoglobin) in which the fetus is usually spontaneously aborted or stillborn and β thalassemia major (defect in the β chain of hemoglobin), also known as Cooley's Anemia. Cooley's Anemia presents in the first year of life as a severe anemia requiring monthly transfusions and progressing to inevitable death during the first two to three decades.[19]

Heterozygotes for thalassemia, those with thalassemia trait, carry one gene for either the α or the β chain deficiency.

Save for an occasional mild microcytic anemia, they are asymptomatic and require no treatment. Thalassemia trait, therefore, is benign. Its major significance lies in its potential for being passed on to offspring as homozygous disease in the event that a carrier were to marry another carrier. Therefore, if carriers were identified and educated, it would be theoretically possible to totally eliminate this disease. And, at the least, carriers of thalassemia trait could be informed so that the decisions made in regard to marriage and childbearing could be based on a sound understanding of the risks.

Thalassemia: Frequency, Detection, and Prevention

Thalassemia is a relatively common disease in Greeks and Italians, occurring in 1:3600 newborns, as compared to the incidence in other genetic disorders: 1 in 3600 for Tay-Sachs and 1:600 for sickle cell anemia. The at-risk couple frequency is 1 in 900 (1 in 150 for sickle cell anemia) in intraethnic marriages.[20]

In recent years it has become possible to screen for thalassemia trait by an accurate, automated, and inexpensive method utilizing the MCV (mean corpuscular volume) of the red blood cell.[13] With this test there are very few false negatives, and false positives are obtained only with iron deficiency, an infrequent disorder in this economically privileged adolescent population.

At the time of the original screening program the only reproductive options for two carriers of thalassemia who wished to prevent the birth of an affected child were mate selection or adoption. In the coming years, however, it will be possible to diagnose thalassemia in the unborn child.[21-23] Prenatal diagnosis, therefore, will allow the option of aborting an affected fetus. "Where a defined recessive disorder tends to occur in a specific ethnic group, and where techniques are available to identify the heterozygote for the recessive mutation associated with that disease, an optimal situation for disease control exists."[20]

CHAPTER 2

Follow-up of An Educational Testing Program: Literature Review

I. Education: Informational Recall

Since the purpose of screening individuals for thalassemia trait is to provide enough information to allow informed reproductive decisions, the quality of the educational program and the retention of information must be critically evaluated for the participants. Compared to other populations studied, how well do adolescents learn about genetically transmitted disease and the genetic risks involved? No study has ever been carefully conducted on the adolescent response to educational programs associated with mass genetic screening. In a follow-up of a Tay-Sachs screening program in Montreal, Beck compared the informational recall of high school students, college students, and newlyweds. She found that high school students scored lower than the other two groups on knowledge of Tay-Sachs disease but not significantly lower than a random aged population.[14] What those scores entail, however, is not clear, and no conclusions can be drawn about what adolescents specifically do (not) understand.

Numerous studies done on adult groups following genetic counseling have attempted to elucidate factors involved in retention of information. Several issues are of interest to our study:

1) Informational recall from genetics counseling sessions has been disappointingly low.[24-25]

McCrae studied 100 families affected by cystic fibrosis in Scotland and Ireland and concluded that only 20% had what could be considered excellent knowledge about their children's disease. Some of the lack of information was attributed to poorly trained physicians in some cases and insufficient interest and follow-up in others. Poor educational background, low intellectual ability, language difficulties, and psychological barriers were also felt to be factors in these parents' poor knowledge. Although these factors might all be important, one major variable was not known. What, in fact, were these parents taught at the time of diagnosis? What, if any, was the educational content of the "genetic counseling session"? Although McCrae states "it must be assumed that some account of the genetics of the disease was given to the parents at the time of the original diagnosis he has no substantiation of this. In fact he finds that "the majority (of these parents) claimed that at the time they were informed of the diagnosis they were given no information about the genetic nature of the disease, or, alternatively, that the information given was inadequate." Therefore, although a study such as this points up the inadequacies of parental education, the evaluation of retention of information that may or may not have ever been distributed and discussed is obviously of dubious value.

Even genetic counseling done under "ideal" circumstances, i.e. university medical genetics clinics with large trained interested staffs or in well-planned organized genetic counseling programs demonstrate that there has been a failure to convey information about the disease to affected families.[1,26] Leonard and Childs interviewed 61 families affected by cystic fibrosis, PKU and Downs Syndrome to evaluate their understanding of the genetic counseling they had received in two Johns Hopkins genetics clinics.[27] All parents were taught the origin of the disease, the risks of recurrence, and the probability of carrier states among unaffected sibs. Interviews and questionnaires were designed to quantify the parents' knowledge of genetics of the disease, the risk of the disease and carrier state, their general genetic and biologic knowledge, and their knowledge of probability. About 1/2 of the parents had enough knowledge to be of any use in decision making; in 1/4 the understanding was flawed in some way and in 1/4 the genetic counseling appeared to serve little function.

Understandably the most optimistic results of education and counseling sessions have been seen in clinics where couples have come requesting information about risks for future children. Carter studied 455 couples in England who had at one time sought advice regarding risks of genetic defects in their offspring.[28] Most of these parents already had affected children and were highly motivated toward prevention of future affected children. Each couple was generally seen once, at

which time questions of risk of recurrence of their child's disease was discussed. And, unlike most other protocols, a directive approach was taken by the counselor regarding the advisability of taking the risk for further offspring. In marked contrast to the other groups mentioned, the majority of these couples had both remembered and understood the key factors. However, because it was usually the couples themselves who had initiated the inquiry, they were to some extent a sample selected for education and intelligence. And, in fact, compared to census data in England at the time this sample was skewed toward a higher than average socioeconomic class. Therefore, one must view with skepticism the applicability of these results to mass education programs.

2) <u>An adequate background in human biology and genetics is fundamental to the participants' understanding and recall of information related to genetics</u>.[11,14,27,29]

Many studies suggest that most adults are ignorant of genetics and that there are problems in comprehension of genetic information specific to their particular disorder.[24,25,27,30] In evaluating their background knowledge, Leonard concluded that parents' knowledge of the genetics of their children's diseases was significantly related to their educational level and also to their comprehension of probability, their general biologic knowledge, and whether or not they had heard of the disease before experiencing it. They conclude that perhaps the greatest obstacle to effective

transmission of genetic information is the lack of basic knowledge of genetics, probability, and human biology as a foundation on which to impose a coherent account of the disease and its pattern of inheritance. Furthermore, those with greater prior knowledge are more likely to utilize informational programs and pamphlets. This results in improving the knowledge of those already most knowledgeable and has little or no effect on those with an inadequate foundation.[31-32] In this respect, it is worthwhile to evaluate the genetic knowledge and background in human biology of the adolescent and young adult.

3) <u>One's ability to understand illness is related not only to the manner in which it is presented but also to the emotional interpretation of the risk</u>.[31]

Sibinga and Freedman studied 79 parents of children with PKU who had been exposed to direct discussions with physicians about PKU, carefully prepared written material and repeated follow-up education at times the children were tested and examined.[33] All parents were said to have been instructed about the hereditary nature of PKU, the risk of recurrence, the enzymatic defect, the potential consequences of the disorder, and the treatment. Despite the "variety and extent of opportunities to assimilate medical information," in a follow-up study a surprisingly low 19% of the parents gave what was felt to be adequately correct answers, i.e. four or more elements mentioned. Furthermore these parents

showed a marked tendency to distort information related to the disease, judged by ambiguous and overgeneralized responses to questions asked. In contrast to the widely held view that parents with greater education are less likely to distort information, no such correlation was found. These authors conclude that "the capability to understand illness might be considered an emotional phenomenon," related to the individuals' perceived seriousness of the disease and the undesirability of its outcome rather than merely to adequacy of education.

Mass education programs associated with screening must necessarily differ from carefully planned genetic counseling sessions in many regards. By definition a large scale education program must be directed at a diverse population; therefore, education cannot be designed to meet each individual's needs. In addition, education of this sort loses the personal aspect which many feel is so important to imparting emotionally laden information. Secondly, but perhaps most importantly, adults receiving genetic counseling generally have an affected child. They are, therefore, more familiar with many aspects of the disease by direct experience and are often highly motivated to prevent the birth of another affected child. In large screening programs, on the other hand, since prevention is the goal, the participants are unlikely to be familiar with the disease at issue. Consequently, they are less likely to be as highly motivated as affected parents.

Added to this is the burden of educating participants about an intangible--a recessive gene. As we have seen, informational retention is often poor even in the most motivated population, the parents of affected children. It is therefore of extreme importance to evaluate the effectiveness of mass screening programs. In this regard, we shall look at the adolescent population screened for thalassemia trait addressing the major issues outlined above:

a) What is the informational recall of adolescents who have been exposed to minimal education through a mass screening program? How important are the factors of sex, education, language, socioeconomic status, intellectual ability in this age-group's understanding of genetic information?

b) What kind of background in human biology and genetics do these adolescents have? Is this age population educationally prepared to receive genetic screening?

c) How do adolescents and young adults emotionally interpret the risks involved in thalassemia?

II. Translation of education into attitudes and behavior

The assumption behind genetic screening and education for preventable diseases such as thalassemia is that awareness of such genes is an important ingredient in decisions about reproduction. To have the knowledge is to enhance freedom of choice.[9] If freedom of choice were an end in itself, genetic screening programs designed to provide reproductive information

would have the desired results automatically by merely informing carriers of their status. However educating the public about genetic disease and informing carriers is of limited value if the freedom of choice is not exercised. One can argue that premarital screening allows the individual a choice in mate selection--carriers could choose whether or not to marry carriers--but, except in artificial situations, there is no evidence to suggest that this goal is realistic.[34]

Most specifically, mass screening and education to provide reproductive information is conceived as a preventive measure, the goal being to prevent the birth of affected children with the eventual hope of significantly reducing the incidence of the disease. However, merely educating a population does not insure that "proper" action takes place. More basically, it does not even insure that the desired attitudes will be adopted.

Several studies of the outcome of genetic screening, the actual reproductive behavior of the participants, demonstrate the difficulties in changing the attitudes and behavior of adults.[27,34] Stomatoyannopolous studied a screening and education program for sickle cell anemia in Orchomenos, a small farming community in Greece where sickle cell anemia is endemic.[34] Since 23% of the inhabitants have sickle cell trait, the population is highly aware of sickle cell disease which poses a major financial and social burden on the community. Of note, however, is that these people are poorly educated

with little or no exposure to biology. Culturally, this population is also unique in that marriages are arranged between the families of prospective spouses. The screening and counseling program was conducted with the hopes of educating people about sickle cell anemia, testing families, informing them of the results and the attendant options and risks, and finally to introduce into their culture a new concept that genotypic information might be considered in marriage plans.

Seven years later, a follow-up study showed that almost all of the families remembered correctly the results of their screening tests and understood their meaning. In addition all the families interviewed reported exchanging the findings of the screening with prospective in-laws and discussing the possibility of sickle cell anemia. In view of the apparent understanding and acceptance of the genetic information, the reproductive performance was telling. Of the 43 carriers interviewed, 1/2 stated that they had conscientiously avoided marrying a carrier and 1/5 of these had broken a marital engagement when they learned that their future spouse was a carrier. One-fourth had concealed their carrier status from their spouse! And, in the last analysis, 4 (4%) trait x trait mating occurred--the same number that would have occurred in random mate selection. Thus there is evidence that even when information is presented, understood, retained, and discussed in plans for marriage that it has no effect on mate selection.

Theoretical models have been proposed which attempt to determine those factors involved in developing health attitudes and behavior.[30-31] Rosenstock, in his health belief model, has compiled research on social psychological theory to illuminate factors influencing health behavior. Social psychological theory states that motivation is required for perception and action. If there is no concern about the potential disease among those screened, they are unlikely to perceive the information given as pertinent to their health. In addition there must be some "readiness to act." Two principal elements define whether a readiness to act exists: (a) the degree to which an individual feels susceptible to a health condition and (b) the perceived seriousness of the condition were it to occur. Thus the individual must not only know that he (or his offspring) could be affected by the illness, but he must perceive the potential illness as sufficiently serious to warrant prevention. On the other hand, the perceived seriousness must not be too overwhelming. If anxiety or fear become strong enough, the person may be rendered incapable of thinking or behaving rationally about the problem.

Accepting one's susceptibility to a disease or trait, considered to be serious, provides the proper attitudinal background, but it does not define the course of action likely to be taken.[31] Numerous barriers to act may overshadow the attitudes. Religious and ethical beliefs may inhibit an individual from "appropriate" reproductive behavior even though he/she

might like to prevent the birth of a diseased child. In addition, behavior is undoubtedly influenced by the norms and pressures of the social group. The Orchomenos program illustrates the importance of these often intangible barriers. Although the participants appeared motivated to prevent the birth of children with sickle cell disease, an outcome which all interviewed considered serious, many were still unable or unwilling to take the necessary steps to prevent the possibility. Just what beliefs and norms played such a strong role in these couples' decisions is not clear. It does seem clear, however, that in evaluating the Greek Orthodox response to genetic screening, strong social norms and ethics must be considered.

A study of pre-reproductive adolescents cannot provide the definitive answer on the actual reproductive behavior of those educated and screened. An attempt will therefore be made to describe this population's "readiness to act" by defining those factors which have been thought to operate in the final behavior:

a) How motivated are these adolescents to obtain screening?

b) What is their perceived seriousness of thalassemia trait and thalassemia major?

c) Do they feel that having the trait will affect their choice of mate?

d) What are their barriers to act? What are their re-

productive attitudes in regard to family size, family planning, and abortion? How do the reproductive attitudes of those with the trait compare to those without the trait?

III. Emotional Impact of Carrying the Trait

"Experience is rapidly accumulating, but 'much needs to be learned about the psychological effects of learning that one carries a mutant gene, not harmful to the carrier, but which can be very harmful when two carriers marry.'[35-36] Extensive screening programs are going on, but we know little about such vital questions as the optimal age for screening, how to counsel with minimum damage and maximum benefit, the psychological effects of being labeled a carrier of a harmful gene, and the social pressures that may be brought to bear on carriers. Will they become social pariahs in their own mind or in the eyes of society? Will pressure be brought to bear against their having children if they choose to take the risk? These and other questions urgently need answers and have aroused so much concern that there is a growing feeling . . . that such screening programs should not be implemented unless there is something more to offer mutant gene carriers than simply genetic counseling. The positive effects of counseling must be weighed against the negative effects. We do not have the data to evaluate either adequately. There is a need for pilot studies in which these factors can be measured before we embark on large scale screening programs."[37]

The literature is saturated with this fear of the psychological effects of labeling one a carrier.[2,15,38-41] Is more harm than good done by informing a large number of people that they carry a gene for a lethal disease? Those who studied the participants in the Washington-Baltimore Tay-Sachs screening program found that "being a carrier was considered by most a serious matter."[42] This was a surprising finding in such a well educated, motivated population with a high awareness that being a carrier was a benign condition. The evaluators of the Dayton Tay-Sachs screening program were so concerned about the psychological stress caused by being labeled a carrier that they decided to discontinue the screening. Kuhr states that "to find one affected child, 72 people have to be identified as carriers . . . The local advisory committee decided that the psychic burden on those 72 heterozygotes was too high a price to pay for the prevention of a single case.[43]

In many programs this fear of psychological harm is prevalent and is even taken into consideration in choosing the "appropriate" age-group to be screened. Kaback demonstrates this type of bias in selecting the population for screening in Baltimore. "Because of potentially greater psychologic problems and misunderstandings in teenagers, the Washington-Baltimore testings were confined to men and women of childbearing age, and principally to married or engaged individuals.[12] (emphasis added) Aside from opinion, however, there is no evidence that adolescents find being labeled a carrier more damaging than

adults. As long as adolescents are excluded from programs, this question cannot be answered. The possibility exists that adolescents, being somewhat less formed in terms of self-concept, and somewhat less threatened by immediate child-bearing responsibilities may be less traumatized by learning that they carry the trait. Also, they might benefit from having more time to assimilate and integrate this information before facing decisions on childbearing. This possibility offers some optimism to the field of genetic counseling and certainly deserves to be explored.

Beck has provided some encouragement to a study of this nature. In discussing the Montreal Tay-Sachs screening she states: "we know that about 15% of persons who find themselves to be a carrier react initially with considerable anxiety to this news until a new attitude is adopted that represents a different level of self-awareness and health perception. In this regard, it will be important to evaluate how high school students as a group handle this new form of mass genetic screening and counseling, since screening of this group, in our experience, is the most efficient approach to screening for Tay-Sachs gene."[14]

Stigmatization of being labeled a carrier

Since many genetic diseases are found primarily in one ethnic minority,[44-45] e.g. thalassemia in Greeks and Italians, sickle cell anemia in blacks, Tay-Sachs in Ashkenazic Jews, this becomes a problem of both social and political relevance.

Of concern to all ethnic groups affected by a disease process is the possible stigmatization of labeling one with a trait. As a consequence of ignoring this most important aspect of genetic screening, many poorly conceived mass screening programs have been conducted. This has resulted in a public which is very unsympathetic to the geneticist and the medical community at large. Several authors have outlined the hazards of indiscriminate screening for sickle cell trait.[2,46-47]

1) Approaching a minority population with a goal of preventing the birth of children has unfortunate social connotations, particularly when the "value" of such prevention is not made clear.

2) Mandatory screening laws were implemented requiring school age children to be tested for sickle cell trait. What was originally intended as a beneficial health service, consequently, became a legal issue. Furthermore, no provision was made in the law for education of parents as well as children. These laws could only be viewed as punative to those being <u>forced</u> to comply.

3) Many people labeled with sickle cell trait became objects of discrimination and stigmatization. Beutler cites examples of loss of employment and discrimination in life insurance availability for some adults. Cases of mistaken paternity were discovered causing a great deal of upset in some families. Children were discriminated in other ways including delay in adoption for children with sickle cell trait.[46]

The hazard of inadequate public education and rampant misinformation can become monumental. In the case of sickle cell anemia, a prevailing notion existed in the community that "sickle cell" was a disease; people did not distinguish between sickle cell disease and trait. To many of the people affected by sickle cell anemia, the concept of a recessive gene is foreign. The understandable assumption of many adults and children alike, therefore, was that a positive test performed by a physician signified disease, and appropriate disease related behavior ensued. The parents of children found to have sickle trait in Seattle were interviewed and found to be quite confused about the significance of the trait. This study reveals many of the unfortunate consequences of presenting an uninformed population the diagnosis of "sickle cell nondisease."[25] The majority of parents (43% carriers/71% controls) thought that the trait was the same as the disease. In these families, the child was in some way penalized for his "nondisease" by having restrictions placed on physical activities (49%), being given dietary supplements (66%) and extra vitamins (29%). Similarly Stomatoyannopolous found that 20% of the sickle cell carriers and 40% of the controls in Orchomenos thought that sickle cell trait was a mild disease requiring restriction of freedom and risk of social stigmatization.[34] These and other studies emphasize the importance of nondisease as a potentially hazardous public health problem.[48-49]

In comparing the thalassemia screening program to similar screening programs for sickle cell trait some differences are found. Since thalassemia affects such a small percentage of the population, no mandatory screening laws have been passed. Furthermore exposure of the public to mass media information is less, reducing the potentially wide-scale misinformation. In addition, since some of the Greek Americans are newcomers to this country, they are likely to be less familiar with the medical practice in this country, making them potentially susceptible to more misunderstanding. The threat of thalassemia "nondisease" is a real one to this population. And similar to the black population in the U.S., the Greek Americans form a minority group, a potential target for discrimination and stigmatization.

An evaluation of the response of the Greek adolescent to screening for thalassemia trait and the subsequent assignment of the carrier status must, therefore, address these questions:

a) How did the adolescent respond initially to hearing the results of the screening? What was the emotional impact?

b) Is being a carrier for thalassemia considered a serious matter?

c) How common is thalassemia nondisease, i.e. confusion between the trait and the disease such that carriers think they have a form of mild disease and are treated as such?

d) Is there any evidence for parental or social stigma-

tization for carriers of the gene for thalassemia? Are they treated differently from their peers and siblings who do not have the trait?

CHAPTER 3

Materials and Methods

Screening and Education Program

During the past three years, beginning in 1972, a community-based voluntary screening program for α and β thalassemia trait was conducted in several Greek Orthodox churches in Connecticut.[13,16-17] The program was a coordinated effort by the Yale Pediatric Hematology department and the Connecticut Campaign Against Cooley's Anemia. Separate screening and education programs were offered annually in each of the Greek Orthodox churches in Connecticut, one in New Haven (1972), New Britain (1973), and Hartford (1974). Although screening was offered to all who attended the session, adolescents and young adults were particularly encouraged to participate.

Objectives

Prior to this program few attempts had been made to screen Greek or Italian populations in the U.S. for thalassemia trait, primarily due to a lack of an inexpensive but reliable screening test.[50-52] This, therefore was a pilot study, conducted with several objectives:

1) To evaluate an inexpensive method for screening carriers for thalassemia.[53]
2) To determine the prevalence of thalassemia trait.
3) To offer and evaluate an educational screening program designed for adolescents, an age group infrequently included

in genetic screening programs in the past.

4) To identify carriers and to provide them with the necessary reproductive information to allow them to make educated decisions regarding future childbearing.

Education Program

Prior to the screening program, information was distributed to the Greek community through church bulletins, newspaper articles, TV announcements, and the pulpit of the Greek Orthodox churches. An attempt was made to familiarize as many people as possible with thalassemia as a problem and to encourage participation in the screening program. At the time of testing, a formal discussion and slide show were conducted, emphasizing the character of the disease, the nature of the defect in Cooley's anemia, the prevalence among Greek and Italians, the meaning of the carrier state (trait), and the genetic risks to offspring. Particular emphasis was placed on the asymptomatic nature of the trait, and on its potential significance in decisions about future childbearing. At the time of these education programs, prenatal diagnosis of thalassemia major was as yet unproven; therefore, the option of prenatal diagnosis and abortion was not presented to the participants.

A pamphlet describing the salient features of the disease and trait, including a description of the genetic risks, was distributed to all participants to reinforce the verbal information. In Hartford, where a substantial propor-

tion of the Greek community is first generation, the program was conducted in both English and Greek.

Screening Program

Immediately following the education program, voluntary testing was offered which involved the procurement of one venous blood sample by trained personnel. All samples were analyzed according to the outline previously described by Pearson.[13] The four common diagnoses made from the analysis were 1) normal 2) β thalassemia trait 3) α thalassemia trait, and 4) Fe deficiency anemia. Several individuals were found to have hemoglobin sβ-thalassemia and hemoglobin sα-thalassemia.

Screening Results

Of the 591 volunteers tested in Connecticut, 74 (12.5%) had β thalassemia trait, 19 (3.2%) had α thalassemia trait, 1 (0.2%) had $\beta\delta$ thalassemia trait, 2 (0.34%) Hemoglobin S trait.[17] The relationship of these percentages to the actual prevalence of thalassemia trait in Connecticut is discussed by Pearson.[16] The frequencies are consistent with those measured by Malamos in Greece for β thalassemia carriers, which ranged from 3.3 - 14.0% in different areas of Greece.[54]

Reporting of Results

In keeping with the policy of confidentiality set by the screening committee, results were mailed in envelopes self-

addressed by the individual at the time of screening. Those found to have normal results simply received them in the mail. Those found to have any abnormality, including β-thal trait, α-thal trait, or Fe deficiency anemia were contacted first by telephone and subsequently sent a copy of their test results in the mail. The purpose of the phone call was to minimize anxiety by attempting to clarify any misconceptions which might exist and offer further explanation of the meaning of the test results. All phone calls were conducted by the same person. The significance of the trait was reaffirmed, again emphasizing its probable asymptomatic nature. Each person was cautioned about unnecessary ingestion of iron supplements, and risks for future childbearing was again outlined. All who received a telephone call were offered testing for family members. They were also offered the opportunity to discuss the test findings with a member of the medical advisory staff. A second copy of the pamphlet was included in each letter. Test results were reported in both English and Greek.

Follow-up Study

Population

The adolescent and young adult population chosen for further study were those between the ages of 12 and 20 at the time of the original testing. Of the 187 total adolescents tested, 14 (7.5%) were identified as β-thalassemia carriers and 4 (2.1%) as α-thalassemia carriers. All fourteen carriers

of β thalassemia trait were matched with controls who had also participated in the screening. Subjects were matched for age, sex, place of residence, marital status, and, as closely as possible, for father's occupation. Because of the already select nature of the original population tested, all were Connecticut residents, all were of Greek ancestry, and all except two were Greek Orthodox. None of those studied had immediate relatives with Cooley's Anemia.

The fourteen adolescents with β thalassemia trait and their controls were interviewed. In addition, 3 adolescents with α thalassemia trait and 2 more controls were interviewed.

Interviews

Personal interviews were conducted with all adolescents having either form of thalassemia trait and their controls.[55-57] Prior to conducting the interview, letters were mailed from the office of the Connecticut Campaign Against Cooley's Anemia announcing that a follow-up study of the screening program was being performed on a group of young adults for the purpose of evaluating such a program so that it might be improved in the future. Letters were followed by a telephone call from the director of that organization, and interviews were scheduled. All of the index cases in the state were contacted successfully, and all were interviewed--a 100% compliance rate.

The interview was originally pre-tested on three adolescents without thalassemia trait. The subsequent thirty-three interviews were conducted in a "double blind" manner with the

interviewer blind to the screening results of each participant.

All interviews were conducted by the author over a 3 month period. If possible, interviews were held at the local Greek Orthodox church where the original testing had been done; some were held at private homes and local universities when that proved more convenient.

The interview covered the following areas: (See Appendix)

1. Reasons for participating in the screening
2. Prior knowledge of Cooley's Anemia
3. Current knowledge of Cooley's Anemia
4. Current knowledge of thalassemia trait
5. Understanding of genetic risks and general genetic concepts
6. Reaction to the test results
7. Reproductive plans
8. Reproductive attitudes
9. Demographic information

The interview included multiple choice and open ended questions. Responses were recorded verbatim; no tape recorder was used. Each interview took approximately one hour. Following the interview the participants asked questions which were also recorded. The interviewer then reviewed all points which, based on the interview response, needed clarification. Discussion following the interview often lasted 30 minutes to 1 hour.

Data Analysis

All of the interview data was programmed into the computer, utilizing Data-text, a computer language designed for social and epidemiological studies.[58]

Multiple cross-tabulations were performed to answer several questions:

1) How well-matched are the experimental group and their controls?
2) How is the subject's status, having trait or not, correlated with knowledge and attitudes?
3) What other factors affect knowledge and attitudes?
4) How are knowledge and attitudes correlated?

All of the continuous variables were grouped into three categories utilizing the mean value on all answers, and two-way cross-tabulations were performed. Several three-way cross-tabulations were run to look at the association between demographic date, knowledge (or attitudes) and having the trait for thalassemia. Appropriate Chi-Square tests were used to test for significance.

The data was evaluated for two separate populations: those with β thalassemia trait and those without. Since it was not possible to match pairs identically, no matched pair analysis was done. Because of the small number of people with α thalassemia trait (3), these were excluded from all data analysis. Since their controls represented varied sexes and age-groups, they were included in the control population

analyzed. The results of the α trait interviews will be discussed separately. In comparing testing programs in the different centers, the New Britain group (2) was also omitted.

Scores

Answers to both multiple choice and open-ended questions were assigned a score for each of the major categories of interest in this study:

1. Knowledge 2. Attitudes 3. Response to test results

Knowledge scores

Five separate scores were assigned for knowledge, including previous knowledge, current knowledge of Cooley's Anemia, current knowledge of thalassemia trait, general genetic knowledge, and specific knowledge pertinent to the inheritance of thalassemia.

Questions on Previous Knowledge were asked to attempt to ascertain how familiar this population was with thalassemia prior to the screening and education program. Because of the lack of accuracy in answering this question, answers were assigned to only two categories: 'had heard of Cooley's Anemia and knew something about it' and 'knew nothing about Cooley's Anemia' before the screening program.

A Knowledge of Cooley's Anemia score was based on a series of 9 points which were deemed by the author to be fundamental, each point earning a score of one:

1. Understood the defect to involve the blood

2. Understood the defect to involve hemoglobin or red blood cells
3. Knew the disease was inherited
4. Knew that treatment involved multiple transfusions
5. Knew the disease was invariably fatal
6. Knew the disease was fatal in the first three decades
7. Had some mental picture of people afflicted with the disease
8. Knew the disease affects Mediterraneans
9. Knew that males and females are affected with equal frequency.

The scores were subsequently subdivided into good ($\geq$ 6), fair (3-6) and poor ($<$ 3) on the basis of the mean score. This basis for division was used for all of the following scores.

A Knowledge of Thalassemia Trait score was similarly assigned based on the information presented in the education program and the pamphlet utilizing the following points:

1. Knew that the trait was not a disease
2. Knew that the trait was a gene (any description of a gene was accepted)
3. Knew that the trait was inherited from parents
4. Knew that the trait was generally not associated with symptoms
5. Knew the trait might be associated with a mild anemia
6. No treatment necessary for persons with the trait

7. Knew the trait might be passed on to offspring

All questions were assigned a score of one, except #1 which was given three points, and the scores were subdivided again into good ($\geq$ 6), fair (3-6) and poor ($<$ 3).

To assess their general fund of genetic understanding, a brief quiz was designed. The General Genetic Knowledge score was, therefore, based on the points emphasized:

1. Understood the concept of dominant-recessive gene
2. Knew that brown-eyed parents could have blue-eyed children
3. Knew how sex is determined genetically.

These scores were assigned to only two categories: good ($\geq$ 2) and poor ($<$ 2).

The Genetic Knowledge Specific to Thalassemia score was based on answers to a variety of both open-ended and multiple-choice questions:

1. Knew both parents must have the trait for the child to inherit the disease
2. Understood independence, i.e. the risks are the same for each child born
3. Knew that the child could inherit the trait from only one parent
4. Knew the frequencies of offspring resulting from a match between two parents with thalassemia trait. (3 points)

Scores were grouped into good ($>$ 4), fair (2-4) and poor ($<$ 2).

Attitude scores

To determine the Perceived Seriousness of Cooley's Anemia, each person was asked to rank Cooley's Anemia and four other "diseases," from the one considered most serious to one considered least serious. Those included:

a. being blind but otherwise normal
b. being confined to a wheelchair but otherwise normal
c. having a childhood disease that causes frequent hospitalizations and discomfort, but no physical or mental impairment and leads to an early death
d. Cooley's Anemia
e. having asthma

Each was given a score from 1-5 according to where it was ranked. The diseases were then ordered according to their mean seriousness score, obtained by adding each individual score.

The Perceived Seriousness of Thalassemia Trait was scored on two separate questions:

1. How serious is thalassemia trait compared to other common problems such as a broken leg, acne, sprained ankle, appendicitis, heart disease, mononucleosis, color blindness?
2. How much would you like thalassemia trait compared to having no cavities, being 4'10" tall, not needing glasses, having clear skin, having your leg in a cast for one month, not having thalassemia trait, being hospitalized for a

minor operation.

Each choice from #1 was scored from 0-3, from 'not at all serious' to 'very serious.' Each choice from #2 was scored from 0-4, from 'not at all' to 'very much.' The diseases were subsequently given a "seriousness" score, arrived at by adding all of the scores from each interview. Thalassemia trait was then ranked against other choices, and rank orders were compared for the trait and control group.

Two scores were designed to assess the individual's attitudes on family planning and abortion. Each person was asked how strongly he or she supported family planning for four reasons: the population explosion, financial difficulties in the family, having a chance of having a child with Cooley's Anemia, having already had a child with Cooley's Anemia. The Support Family Planning score was obtained by assigning a score of 1-4 for the possible choices of 'not at all,' 'slightly,' 'strongly,' 'very strongly.' The scores on each point were added to arrive at a total possible score of 16. These were then subdivided into low ($\leq$ 11), middle (12-13), and high (14-16) based on a median of 12 for the entire group.

The Support Abortion score was arrived at by asking how justifiable abortion was in the events: that the pregnancy were a threat to the life of the mother, that the mother were unwed, that there were a chance of having a child with Cooley's Anemia, that a definite prenatal diagnosis of

Cooley's Anemia were made. Again, each answer was scored from 1-4 for 'not at all justifiable,' 'somewhat justifiable,' 'pretty much justifiable,' 'very justifiable.' These scores were added and the possible score of 20 was subdivided into high (16-20), middle (11-15) and low ($\leq$ 10) based on a median of 14 for the entire group.

Response to Test Results

In order to simplify the interview responses on the Response to Test Results, answers were grouped into three categories: upset, relieved, no effect. A subjective discussion of these responses will be included in the discussion to follow.

Demographic data

All continuous variables including age, grade, father's occupation, mother's occupation, father's education, and mother's education were divided into three categories based on the median response. The Duncan Code of Occupational Prestige was used, which ranks occupations from 0-98.[59]

CHAPTER 4

Results

Population

In the three testing programs conducted, individuals between the ages of 12 and 20 were screened. Of those, 14 (7.5%) were found to carry the gene for β thalassemia and 4 (2.1%) for α thalassemia. All subsequent results will be reported for the β thalassemia traits and the controls (N=16) only. The α thalassemia results will be commented on separately.

At the time of the original testing, the ages of the participants ranged from 12-20 with the mean being 15.8, and their grade in school ranged from 6th to graduate, with a mean of the 11th grade. When interviewed, their mean age was 18, with a range from 12-23, and their mean grade completed was the 12th, with a range from 7th to graduate school. At the interview time 5 traits and 4 controls were employed full-time; 21 were students (Table 1).

There were 13 males and 17 females. All were single at the time of testing. Two of the females had married since the original screening, and one had just had her first child. The vast majority were Greek Orthodox with 2 affiliated with the Episcopal church.

Three places of residence were represented: 17 were from Hartford, 11 from New Haven, and 2 from New Britain.

Table 1. Age and grade of the population when screened and when interviewed

		# Traits	# Controls
Age at screening:	12-14	4	6
	15-16	4	4
	17-20	6	6
Age now:	13-16	4	5
	17-18	4	5
	19-23	6	6
Grades at screening:	6-9	4	6
	10-12	8	8
	12	1	1
Grades now:	7-10	4	6
	11-12	3	4
	12	7	6

These populations corresponded with the year of testing, with Hartford's screening program carried out one year ago, New Britain's two years ago, and New Haven's one year ago.

The mean family size of these adolescents was 2.9, with 10 having 3 children, 12 having two or less, and 8 having four or five. The paternal occupation scores ranged from 15-85 with a median of 38, indicating that the majority of fathers held blue-collar or low white-collar jobs. The maternal occupation scores were somewhat higher, with a median of

61 and a range from 15-72. Twelve mothers were housewives. The median education level completed for both parents was the 12th grade, with 10 fathers and 3 mothers having obtained a college or graduate degree. The education level ranged from 6th grade completed in Greece to Ph.D. obtained in the U.S.

Two markers for degree of acculturation were used: language spoken at home and generation American. Three of the participants speak Greek only at home; 11 speak only English; 16 are bilingual. The majority of those who are bilingual indicated that the predominant language spoken at home when they were children was Greek, but as they became older English had become the major language.

Prior to the screening program, 8 (27%) had been thought to be anemic, and all of them had received iron therapy for variable amounts of time, some for 2 years.

Matching traits and controls

Despite some discrepancies in category size, the β trait population and their controls were well matched ($p > .5$) for current age, age at the time of screening, grade now, grade when screened, sex, marital status, residence, family size, sibling position, father's occupation, father's education, mother's occupation, mother's education, years since testing, employed full-time ($p=.4$), religion ($p=.2$), generation American ($p=0.12$; those with the trait were more likely to be 2nd or 3rd generation), and grade average ($p=0.18$; more controls had a B average). The only significant demographic

difference between the trait group and the controls was in language spoken, with controls more likely to speak Greek only at home and the traits more likely to be bilingual. (p=.047) An equal number spoke English only at home.

There was a trend illustrating that more people with thalassemia trait had been anemic and had received iron therapy in the past. (p=.072) Of the 8 people who had been anemic, 6 of them were traits and 2 were controls.

Participation in the Program

All adolescents chosen for this study were registered in the original testing and education program conducted in their church. Most were informed of the program by church workers or church bulletins. On questioning them about the original program, 7 (23%) either could not remember hearing the talk or claimed to have missed most of it by being too late. The other 77% remembered being given a talk and slide show. Everyone remembered being given a pamphlet; 4 still have it. There was no difference in the two experimental populations in these two variables.

Motivation to Participate

a) Over half (57%) of the adolescents admitted to being encouraged by their parents to participate. The other 43% were self-motivated. Those who were other-motivated were most likely to state that "my mother made me"; one even said that her mother had "forced" her to participate. Those

who were self-motivated gave reasons: "I went knowing that I would find out if I had the trait and that's a good thing to know." "I wanted to know if I had a trait and also because my godmother's children were afraid of it, so I wanted to take them and show them it wouldn't hurt."

b) There was a difference in motivation between those with the trait and the controls, the controls being more self-motivated and the traits being more other-motivated! (p=.05) (Figure 1)

Figure 1. Motivation to participate

	B Trait	Control
Self	21.4%	62.5%
	3	10
Other	78.6%	37.5%
	11	6

p = .05

In comparing the four sibling groups in which one had the trait and one was a control, two groups disagreed in their motivation. In both, those with the trait reported being other-motivated, stating that "my mother made me," and those who were controls claimed to be self-motivated: "I knew it was something important because we knew a family with a child who died of it. We thought it was important to know." "We had nothing to lose and something to gain."

Previous Knowledge

When asked to recall how much they had known about thalassemia before the screening test, 21 (70%) stated that they had never heard of it or that they had heard it mentioned but knew nothing about it. There was no significant difference between the trait and control population, or between the anemic and non-anemic population in this regard.

Knowledge of Cooley's Anemia

Over half of the participants (16) said that they had at one time known someone with Cooley's Anemia, suggesting that this population might have a greater than average exposure to knowledge about the disease. However, only 11 (37%) had what was considered a good understanding of the disease, 13 (43%) had a fair understanding, and 6 (20%) had a poor understanding. Of the separate aspects of the disease, 8 understood the defect, 4 knew the symptoms, 21 knew the disease was fatal, 12 had a mental picture of someone with the disease, 13 knew that males and females were affected equally, and 28 knew the disease was inherited. (Table 2)

There was no significant difference between the trait group and the control group in understanding of the disease. Knowledge was not related to age, education, grade average, years since testing or any of the other demographic variables described. Those who claimed to have known something about Cooley's Anemia before the screening program had higher scores on their knowledge of the disease. ($p=.033$) Similarly,

Table 2. Knowledge of Cooley's Anemia

	#total	%	#trait	%	#controls	%
Good knowledge	11	37%	5	50%	6	37.5%
Fair knowledge	13	43%	6	43%	7	43%
Poor knowledge	6	20%	3	21%	3	19%

	Total	Trait			Control		
	%total yes	#yes	%	#no	#yes	%	#no
Understood the defect	27%	3	21%	11	5	31%	11
Knew symptoms	13%	3	21%	11	1	6%	15
Knew disease fatal	70%	11	78%	3	10	62%	6
Had mental picture	40%	4	28%	10	8	50%	8
Knew treatment	60%	8	57%	6	10	62%	6
Knew disease,Medit.	97%	13	93%	1	16	100%	0
Knew males=females	43%	5	36%	9	8	50%	8
Knew disease inherited	93%	14	100%	0	14	87%	2

those who claimed to know someone with the disease showed a tendency (p=.08) to know more about the disease. There was no association between knowledge of the disease and either hearing the original talk or reading the pamphlet.

Those tested 3 years ago knew slightly more than those tested 1 year ago. (p=.196) The group tested 3 years ago was

older (p=.009), less likely to speak Greek (p=.081), had less highly educated fathers (p=.045) than the group tested 1 year ago. This difference between the years tested is notable. We have already seen that knowledge of the disease does not correlate with age, language, and paternal education.

Knowledge of Thalassemia Trait

Fourteen of the total have the trait themselves, and an additional 8 know someone who has the trait. Therefore, only 8 (27%) do not know anyone with thalassemia trait. One half, or 15, had what was scored a good knowledge of the trait, 9 (30%) had a fair understanding, and 6 (20%) had a poor understanding.

Those with the trait knew significantly more than those who did not have the trait. (p=.013) (Figure 2) No one with thalassemia trait had a poor understanding while 6 of the controls did.

Figure 2. Factual knowledge trait x trait

knowledge	trait	control
good	50% 7	50% 8
fair	50% 7	12% 2
poor	0	40% 6

p = .013

In knowledge of the individual aspects of the trait, 19 had a good concept of the meaning of trait, and 22 knew the difference between the trait and the disease. Of those 8 who did not, 14% were traits and 38% were controls. When asked what the symptoms and treatment for thalassemia trait were, 19 correctly responded (79% of the traits and 50% of the controls). Significantly, of the 12 who knew that one with the anemia of thalassemia trait need not take iron, 9 had the trait themselves. (p=.017) However, no one understood the reason for this. (Table 3)

Table 3. Factual knowledge of thalassemia trait

	#(%)total	Trait yes	%	Control yes	%	p-value
Understood concept of trait	19 (64%)	11	78.6%	8	50%	.215
Knew difference between trait and disease	22 (73%)	12	85.7%	10	62.5%	.155
Knew symptoms, treatment	19 (64%)	11	78.6%	8	50%	.215
Knew about Fe treatment	12 (40%)	9	64.3%	3	18.8%	.017
Understood Fe treatment	0	0	0	0	0	--

Knowledge of thalassemia trait was also significantly related to knowing someone with the trait, but it was not associated with any other variables described. Of interest, however, those who stated that they were self-motivated to participate in the program were more likely to score high on the factual knowledge. (p=.061)* This relationship was somewhat stronger for the traits alone. (p=.051) Thus it seems that the combination of having the trait and being self-motivated to participate provided the best results on knowledge. There was no association between knowledge of the trait and hearing the talk or reading the pamphlet.

General Genetic Knowledge

Almost all of the participants (26) had received some coursework in high school or junior high school covering human genetics. In response to some general questions on the subject, 13 (43%) demonstrated a good background in genetics, and 17 (56%) had a poor understanding. About half (14) appeared to have a basic understanding of the dominant-recessive concept. Almost everyone (26) answered correctly that brown-eyed parents could have children with blue eyes. Half (15) knew that the sex of the fetus was determined by the father's sperm. There was no significant difference between the trait and control population on any of these points.

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*As we have already seen, those who were self-motivated were more often controls and those who are other-motivated are more likely to be traits.

Surprisingly, general genetic knowledge was not associated strongly with grade average, age, acculturation, or any of the other demographic and knowledge variables. When the trait and controls were compared, some significant differences emerged. Among the trait population, those who spoke English at home (p=.011), had more educated fathers (p=.033) or mothers (p=.089), and those tested only 1 year ago (p=.044) had greater knowledge of genetics.* In the control population, those who had completed more schooling had greater knowledge, (p=.038) but in the trait population genetic knowledge was not related to education.

Those with the trait who heard the original talk were more likely to do poorly on general genetic knowledge. (p=.009) In contrast, those with the trait who had read the pamphlet were more likely to do well in genetic knowledge. (p=.028)

Specific Genetic Knowledge

In response to questions pertaining specifically to thalassemia and its mode of inheritance, only 7 (23%) demonstrated good understanding, 11 (37%) had a fair understanding, and 12 (40%) did poorly. Those with thalassemia trait, however, knew significantly more than the controls, with 86% of them compared to 37% of the controls having a fair or good understanding of the genetics of thalassemia. (p=.012) (Figure 3)

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*As we have seen, those tested 1 year ago were younger, were more likely to speak Greek only, and had more educated fathers.

Figure 3. Knowledge of Genetics of Thalassemia

	trait	control	
good	42.9%	6.3%	
fair	42.9%	31.3%	p = .012
poor	14.3%	62.5%	

Almost everyone knew that the disease was inherited from the parents; 21 knew that both parents must have the trait for the child to inherit the disease, those with thalassemia trait being significantly more knowledgeable. (p=.035) In regard to the frequencies and probabilities of given reproductive outcomes, those with thalassemia trait scored higher. That two parents with thalassemia trait have a 25% chance of giving birth to a child with Cooley's Anemia showed a highly significant split between controls and traits, with 86% of the traits and 31% of the controls answering correctly. (p=.009) (Table 4)

In addition to 'having thalassemia trait,' several other variables showed some association with specific genetic knowledge. These included # siblings (p=.011), grade average (p=.004), knowing someone with thalassemia trait (p=.001), and knowing someone with Cooley's Anemia (p=.024). All eight who did not know someone with thalassemia trait had a poor knowledge of the genetics. Those who demonstrated a poor general genetic knowledge were more likely to do poorly on specific

Table 4. Knowledge of the Genetics of Thalassemia

Statement	Traits	Controls	p-value
Knows that both parents must have the trait for the child to have the disease	92.9%	50%	.035
Knows that the disease is inherited	100%	87.5%	n.s.
Understands independence	42.9%	18.8%	n.s.
If someone with the trait were to marry someone without the trait:			
a) what is the chance that their children have the trait?	35.7%	37.5%	n.s.
b) what is the chance that their children have the disease?	93%	50%	.014
If someone with the trait were to marry someone with the trait:			
a) what is the chance that their children have the trait?	50%	25%	n.s.
b) what is the chance that their children have the disease?	85.7%	31.3%	.009
c) what is the chance that their children be normal?	42.9%	43.8%	n.s.

genetic knowledge. (nonsignificant) It was also noteworthy that all who were born in Greece and 4/5 of those who spoke Greek only at home did poorly. Therefore a poor knowledge

was associated with not knowing someone with thalassemia trait, poor general genetic knowledge, being born in Greece, and speaking Greek at home.

Perceived Seriousness of Cooley's Anemia

The participants were asked to rank Cooley's Anemia in order of seriousness with 'being blind,' 'being confined to a wheelchair,' 'having asthma,' and a description of a disease similar to Cooley's Anemia. Nine (4 traits/5 controls) ranked it as most serious, 12 (5/7) ranked it second, 3 (2/1) ranked it third, and 6 (3/3) ranked it fourth. No one considered it the least serious. After assigning rank scores Cooley's Anemia ranked second after a description of a disease similar to it for the trait population. For the controls, it was ranked first. (not significant) (Table 5)

Table 5. Perceived Seriousness of Cooley's Anemia (ranked from most serious to least serious)

Traits	mean score*	Controls	mean score*
1. Disease similar to Cooley's	4.0	1. Cooley's Anemia	3.9
2. Cooley's Anemia	3.7	2. Disease similar to Cooley's	3.8
3. Being blind	3.6	3. Being blind	3.4
4. Being confined to wheelchair	2.6	4. Being confined to wheelchair	2.8
5. Having asthma	1.1	5. Having asthma	1.1

*Total possible score = 5

When asked what they thought it would be like to have Cooley's Anemia, 12 thought it would be extremely bad, 6 felt that it would be fairly bad, 3 thought that it would not be bad at all, and 9 had no idea what it would be like. There was no difference between the trait and control population in response to this question.

Perceived Seriousness of Thalassemia Trait

In response to the question on the seriousness of thalassemia trait, 5 people answered that it was 'very serious,' 12 that it was 'pretty much serious,' 12 that it was 'mildly serious,' and 1 that it was 'not serious.' (Appendix, p.10) When scored and compared to the other conditions asked, thalassemia trait was ranked #2 for the total population, #4 for the traits, and #2 for the controls. Most people thought that thalassemia trait was less serious than heart disease and appendicitis but more serious than mononucleosis, color blindness, broken leg, acne, or sprained ankle. (Table 6)

The difference between the control group and the traits in perceived seriousness of thalassemia trait is not statistically significant. (p=.102) All who thought that thalassemia trait was 'very serious' were controls. (Figure 4)

There was an association between sex, generation American (p=.004), and language spoken at home (p=.003) and perceived seriousness of thalassemia trait. Females, those born in Greece, and those who speak Greek at home were more likely to consider the trait more serious. There was no significant

Table 6. Perceived Seriousness of Thalassemia Trait (ranked from most serious to least serious)

rank	Total	Score* (mean)	Trait	Score* (mean)	Control	Score* (mean)
1.	Heart disease	2.7	Heart disease	2.7	Heart disease	2.7
2.	Appendicitis	1.7	Appendicitis	1.85	Thalassemia trait	2.0
3.	Thalassemia trait	1.7	Mononucleosis	1.64	Mononucleosis	1.7
4.	Mononucleosis	1.65	Thalassemia trait	1.36	Appendicitis	1.55
5.	Color blindness	1.23	Color blindness	1.28	Broken leg	1.3
6.	Broken leg	1.17	Broken leg	1.0	Color blindness	1.25
7.	Acne	.77	Acne	.71	Acne	.81
8.	Sprained ankle	.54	Sprained ankle	.36	Sprained ankle	.69

*Total possible score = 4

Figure 4. Perceived Seriousness of Thalassemia Trait

	trait	control
not serious	7.1% 1	
mildly	50% 7	31.3% 5
pretty much	42.9% 6	37.5% 6
very serious		31.3% 5

p = .102

association found between the perceived seriousness of the trait and any of the other variables including factual knowledge of the trait. When the trait and control populations were looked at separately, however, those with the trait who had a good knowledge of the disease were more likely to think thalassemia trait more serious. (p=.089) (Figure 5)

Figure 5. Factual knowledge of disease (trait only)

Seriousness thalassemia trait	good	fair	poor
not serious			1
mildly serious	1	4	2
pretty serious	4	2	

p = .089

In response to the questions of how much they would like 'having thalassemia trait' and how much they would like 'not having thalassemia trait' compared to other problems, both the trait and control groups appeared to most like 'not having thalassemia trait,' above all. (Table 7)

The individual cases who felt that thalassemia trait was 'very serious' had some misunderstandings. None of them had the trait.

Table 7. How much would you like these disorders? (ranked from like most to like least)

Trait	mean score**	Control	mean score**
1. not having thalassemia trait	3.7	1. not having thalassemia trait	3.8
2. having no cavities	3.6	2. having no cavities	3.6
*3. having clear skin	3.4	3. having clear skin	3.4
4. not having to wear glasses	2.9	4. not having to wear glasses	3.2
5. having a leg in a cast	.57	5. having a leg in a cast	.75
6. being 4'10" tall	.57	6. being 4'10" tall	.56
7. being hospitalized for a minor operation	.57	7. having thalassemia trait	.56
8. having thalassemia trait	.43	8. being hospitalized for a minor operation	.37

*Significant difference for the traits and controls at p=.051

**Total possible score = 4

Case 27: M.T. is a 14 y.o. male, in the 7th grade. He is first generation Greek, and Greek is spoken at home, but his English is fluent. His knowledge of both the trait and the disease was poor. He thought that the trait could be contagious: "You could spread it to someone else or someone could catch it from you if you have sex with them." And he thought the trait was a disease itself: "you won't be able to cure it. If you find out you got it, you'll go to the doctor and they'll give you some kind of medicine for it." Most importantly, he felt that all of the conditions asked about were 'very serious' with the exception of sprained ankle and mononucleosis.

Case 29: M.C. is the 22 y.o. married sister of M.T. who also was born in Greece and who speaks broken English. She completed high school with a C+ grade average. Her knowledge of the disease was fair, but when asked what the trait was, she responded: "I don't know what you mean. You have to go to the doctor and be checked to see what he can do. I would feel awful if I had it. It's important to know because then you can be cured maybe. If you have it and you don't know and you go have children, your kids are going to have it too." Like her brother she scored everything as 'very serious' except acne and sprained ankle.

Case 31: T.M. is a 19 y.o. male freshman in college. He is also a first generation American who has lived in the U.S. for 9 years and who speaks fluent English. A cousin of his has Cooley's Anemia, and his knowledge of the disease was good. His knowledge of the trait was also excellent. When asked why he was tested, he said: "After I've seen my cousin, I decided to go. It's kind of scary to tell you the truth." He responded to being told that he did not have the trait with "great relief." When asked whether he wanted his mate tested for the trait, he emphatically stated: "Yes. I wouldn't want the children to get the trait." Unlike the first two cases, he scored only the trait and heart disease as 'very serious,' those being considered far more serious than any of the other choices.

Case 33: G.S. is a 16 y.o. second generation male who is bilingual at home. He had the trait and the disease somewhat confused. When asked why he thought it was important to diagnose the trait he responded: "so they can find a way to stop the trait from being passed on, run all kinds of tests--try different medicines--some radioactivity maybe, some way to kill the cells" as if the trait were a cancer-like disorder. "It might be dangerous to my wife, because I could pass the trait on to her." When asked if there were any dangers of not knowing one had the trait: "Oh yeah!! You could get a

sudden attack or your condition could deteriorate, and it would be dangerous." He also thought that only heart disease was as serious as the trait.

Case 20: J.A. is a 19 y.o. female high school graduate who is third generation American and speaks English only at home. She knew someone who had died of Cooley's Anemia. Her concept of the disease was somewhat distorted. Although she understood the genetics fairly well, she had an image of the disease as being associated with birth defects and speech impediments. She also had a minimal grasp of the trait, not knowing whether or not there were symptoms or treatment. She thought that aside from thalassemia trait, only heart disease and mononucleosis were 'very serious.'

These five cases illustrate that those who perceive the trait as 'very serious,' are less acculturated and have a relatively poor understanding of the trait.

Marriage and Child-bearing Plans

Most felt that their ideal family size would be small, with 15 wanting 2 children only, 9 wanting 3, and only 4 wanting 4 children. Only two (one trait and one control) felt that having the trait might influence their choice of mate; 3 did not know. The remaining 15 emphatically stated that it would not change their plans. However, when asked how marrying someone with the trait might affect their childbearing

plans, 5 (36%) of those with the trait said they would adopt, 4 (29%) said they would have no children rather than take the chance, 2 (14%) did not know what they would do but they would be concerned, and 3 (21%) would not change their plans at all.

Examples of individual responses follow:

> "Not very much has changed in my future plans. Just the fact that there's a possibility of a decision. I've thought about this. When the time comes for me to have children, I'll find out the latest lowdown. If there are no other options, I would probably adopt kids."
> (21 y.o. F)

> "I'll have to be cautious as far as marriage is concerned. If I were to marry a girl that had it, I would be careful not to have any offspring. I would also consider adoption."
> (19 y.o. M)

> "If I marry someone who could have the trait, I would get him tested. Then we'd make a decision together about what we want to do. It's a hard decision." (15 y.o. F)

> "Now that I know I have the trait I'll be careful. I'll find out if the person I marry has the trait. I would not have children if my wife had the trait."
> (13 y.o. M)

Predictably, the controls differed significantly in their responses, with 12 saying that marrying someone with the trait would not affect their childbearing plans. (p=.002) However an additional 4 (25%) stated that in some way they would be concerned about having children. These four all had some common misunderstandings which caused them to worry. Two of the four have been mentioned previously as considering thalassemia trait 'very serious.' (#29 and #33) As we have seen, they have multiple misunderstandings. Two thought that

it might be possible to contract the trait later in life; both felt that they should be retested at every opportunity in case they should get the trait at some time. Another thought that the children could inherit the trait from grandparents:

> "The trait might be in there from the parents or grandparents. Even if neither of us has it, the child might. It does happen." (18 y.o. F)

Therefore, she considers having children a risk, even though she does not have the trait.

All trait carriers wanted both their prospective mate and all of their children tested for thalassemia trait. Almost everyone, traits and controls alike (26), wanted their mates tested regardless of ethnic ancestry, and 3 (controls) would like the mate tested if he/she were Greek or Italian. Only one person (control) thought that the mate testing was unnecessary. Similarly almost all (27) would like their children tested regardless of their mate's carrier status, and an additional 3 (controls) would like their children tested only if their mate were a trait carrier.

Support Family Planning

The support for family planning was high in this group of adolescents and young adults. Out of a possible total score of 16, the mean and median score was 13, with scores ranging from 7-16. Those with thalassemia trait were somewhat more supportive of family planning, but not significantly so. After scoring and ranking the individual instances in which limiting

family size might be desirable, 'having a child with thalassemia major' was ranked first, followed in order by 'having a chance of having a child with thalassemia major,' 'having financial difficulties,' and 'population explosion.' (Table 8) (See Appendix, A9)

Table 8. Reasons for supporting family planning (ranked from support most to support least)

	Total Mean Score*	Trait Mean Score*	Controls Mean Score*
1. having had a child with Cooley's	2.5	2.7	2.4
2. having a chance of having a child with Cooley's Anemia	2.3	2.5	2.1
3. having financial difficulties	2.1	2.3	1.9
4. population explosion	1.8	1.9	1.8

*Total possible score = 4

Those with a high support for family planning were more likely to be female (p=.026) and to be employed full-time. (p=.005)* Those who demonstrated a low support for family planning appeared to equally represent all age groups, education levels, and socioeconomic levels. Those with a good factual knowledge of the disease were more likely to support family planning for both reasons related to Cooley's Anemia. (p=.128)

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*This difference cannot be distinguished from the sex difference, since all who are employed full-time are female. (p=.002)

When support of family planning is looked at in terms of both age and sex, a significant difference is found in the oldest age group, 19-23, where 6 females have a high support for family planning and no males.* (p=.015) There is no significant sex difference in the other age groups, and in fact the younger males and females appear to score as highly as the older females.

When sex difference is examined separately for traits and controls, the significant difference appears only in the trait population! Females with thalassemia trait are more likely to have a high support for family planning than males. (p=.029), but the male and female controls show no such difference (p > .5). (Figure 6)

Figure 6. Support for family planning among those with trait

Support for Family Planning	Trait Males	Trait Females	
low	1	0	
middle	4	1	p = .029
high	1	7	

*Since 6/8 of the 19-23 age group are female, it is difficult to distinguish the age-sex difference from a sex difference.

When those employed full-time are examined separately for traits and controls, a trend is found in both populations showing that those employed are more likely to support family planning whether they have the trait or not. (p=.055 for traits and .077 for controls)

Support Abortion

The support for abortion was not as high in this group as the support for family planning, and there appears to be a wider dispersion of the mean and the median, indicating a wider skew in the scores. Out of a total score of 20 for each individual, the mean score was 14.5 and the median was 16, with scores ranging from 8 to 20. The questions asked and the responses appear in the Appendix. (Appendix A9)

Except for 'chance of having a child with Cooley's Anemia,' where the p=.064, there were no differences between the trait and the control group in responses. After scoring and ranking the individual responses, the 'threat to the mother's life' was ranked first, as the most justifiable reason for having an abortion followed by 'definite prenatal diagnosis,' with 'chance of having a child with Cooley's Anemia' ranked third for the trait population and fourth for the controls. (Table 9)

One highly significant association was found between generation American and support for abortion. (p=.010) All of those people who were born in Greece scored low on support

Table 9. Reasons for supporting abortion (ranked from support most to support least)

rank	Traits	mean score*	Controls	mean score
1.	threat to mother's life	2.9	threat to mother's life	2.8
2.	definite prenatal diagnosis of Cooley's	2.8	definite prenatal diagnosis	2.1
3.	chance of having a child with Cooley's	2.4	unwed mother	1.6
4.	unwed mother	1.5	chance of having a child with Cooley's	1.4
5.	unplanned child	.93	unplanned child	1.1

*total possible score = 4

---

of abortion. No other associations were found with age, grade, sex, employed, socioeconomic status, grade average, or factual knowledge of the disease. Trait subjects with a good knowledge of the trait were more likely to support abortion in the event that there were a chance of having a child with the disease. (p=.172) There was no association for the controls.

Response to Test Results

When asked what their reaction was when they learned the results of their screening, 6 answered that they were upset for a variable period of time, 11 expressed a feeling of relief, and 13 accepted the results or felt no effect.

These responses were substantially different for the trait group and the controls. (p=.001) Only those with the trait were at all upset, and only the controls were relieved. However, 8 traits and 5 controls reported no response to learning the test results. (Figure 7)

Figure 7. Response to test results

	trait	controls	
upset	42.9% 6		
relief		68.8% 11	p = .001
no effect	57.1% 8	31.3% 5	

In focusing on those with the trait, several factors seemed to be associated with their response to the test results. Females with the trait were more likely to be upset, and males were more likely to express that the results did not affect them at all. (p=.087) Those who spoke English only were more upset than the bilingual group. (There were no Greek speaking traits.) (p=.037)

In looking at the control population, those who spoke Greek only were more likely to experience relief than no effect when they were told their test results. (p=.016) It is

noteworthy that both first and second generation Americans all expressed relief in response to their test results. (p=.113) No other variables including age, education, or marital status were associated with the response to test results.

The verbatim responses of the adolescents with the trait to the test results illustrate more clearly their emotional responses. Of the 8 who expressed 'no effect' the responses varied from nonchalance to surprise. Some had developed defenses to protect against the information. One was relieved because he was afraid that he might be told he had the disease!

> "Big deal! It means nothing to me. It's only the trait." (18 y.o. M)
>
> "I was grateful, because I think it's good to know." (23 y.o. F)
>
> "I thought I would have it. I guessed I would. I was not surprised or sorry or anything like that." (13 y.o. M)
>
> "I wasn't really surprised because I knew I probably had it--my parents are both from Greek backgrounds. I wasn't upset. If it was serious I probably would be, but it's not that bad." (18 y.o. M)
>
> "I didn't think I could have it, because I had never heard of it before so it couldn't be that important so why bother. I was kinda surprised. I had sorta forgotten about it. I wanted to know more about it and know exactly what was going on. At first I wasn't sure what they meant by the trait. I was not frightened--just surprised." (15 y.o. F)
>
> "Of course I had hoped there would be no trait or disease, but the trait was better than having the disease. I thought I might

> have the disease. I listened to that talk, found out it wasn't that dangerous so I don't mind. It's no big deal." (21 y.o. M)
>
> "At the time it didn't bother me. Everyone was telling me not to go out with Greeks or Italians, and I don't usually." (19 y.o. F)

Of the 6 people with the trait who were upset in response to the test results, the overwhelming feeling was that they had forgotten the significance of the trait, and one had actually missed the original program. They all expressed a need to obtain more information. Said one 18 y.o. male with the trait: "It was a good program, but I didn't pay much attention. You don't pay attention till you have it--that's why I'm here now." Also those who were dating Greeks or Italians at the time were more likely to be upset. Although they had reacted originally by becoming upset, through the processes of obtaining more information or developing some defenses, most had managed to incorporate the information.

> "When they first told me that I had the trait, I got all scared. When they finally explained what it was, I felt better. (She had missed the original program.) Then my mother told me she had it all her life and I felt much better. Now it doesn't bother me." (15 y.o. F)
>
> "It didn't affect me. Well, I was kinda worried--just after I found out. Then I read a little more of the information that I had gotten from the church." (19 y.o. M)
>
> "I was dating an Italian at the time. I was a little upset, to tell you the truth. I guess I didn't know enough about the disease or the trait at the time. I would like to

> read some more about it. I had the choice of setting up an appointment with the doctor and I didn't go. They assured me that there was nothing wrong with me. Said I could pass it on to my children. Then I worried about having children with the disease. It was on my mind for over a week. Then I more or less took it out of my mind. Then I married someone (from English ancestry) I didn't think would have it. I did consider it when I decided to get married. I'm glad I knew. My parents were concerned. I think my mother (who had the trait) would feel guilty if I were to marry someone with the trait."
>
> (21 y.o. F)

The concern was expressed in some unusual ways for one girl who experienced a change in her self image:

> "I wasn't prepared. It was really strange. It almost felt like there was something physical. I would look at my hand . . . Just the thought that there was something there that I didn't know about. I wanted my boyfriend to get tested. I wasn't exactly scared because I knew I couldn't get it. It was just a weird feeling--I always considered myself 'normal.'"
>
> (21 y.o. F)

One 18 y.o. female had particular difficulty becoming comfortable with the information. She had been symptomatically anemic for several years and was somewhat worried already. Subsequent to the testing, she remained symptomatically anemic. Her mother treated her as if she were unwell, and had been giving her food supplements. In addition, she was seriously dating a Greek.

> "I thought for sure I wouldn't have it. I started crying. I really didn't know that much about it and I got scared. I thought I would be sick from it. I'm going to have to watch who I marry. At the time I was dating a Greek. I thought that when I got

> older, it would get worse. I thought it was more like the disease; I thought I would be tired all the time. They just said you can't have iron. I don't understand that about the iron. Anyway, I felt better after they explained it to me again. But my mother is overprotective. She was very upset at first. Now she bothers me to eat all the time, stuff like spinach juice and liver. I feel like a little kid again." (18 y.o. F)

Response to Testing Program

When asked their opinion of being tested, all stated that they were glad they had been tested. In addition, all would recommend a similar testing program to a friend. When asked what they thought the ideal age for screening was, 12 recommended grade school, 11 junior high, and 7 high school. Many of the older people expressed that the screening program might have been too late for them had they already been married. Although 15 felt that their age was a good age for screening, 14 (47%) felt that it was too late. Only one (control) felt that it had been too early for him. There were no differences between the traits and controls on responses to these questions.

In an attempt to ascertain the impact of the screening program on these adolescents, they were asked how often they think about the results of their testing, had they gone for further counseling, whether they discussed the results with others outside their families, and whether they had looked up additional information about thalassemia after the screening. Very few think about the results: 10 said they never did,

10 seldom, 8 occasionally, and only 2 often. Seven of the traits and 3 of the controls think about the results occasionally or often and 7 controls and 3 of the traits claimed to never think about them. Interestingly, the two who thought about the results 'often' were the two married participants. Only one had the trait. The other is a 22 y.o. first generation female (Case 29, page 59) who had 2 weeks before the interview given birth to her first child. She expressed some worries that she might some day have the trait, even though her screening was negative. Furthermore, her husband had never been tested.

No one had taken advantage of the offer to receive additional counseling with a member of the medical staff. Only 5 had looked up additional information; 4 of these had the trait. Most people talked to someone outside their family about their results. Of those, 13 spoke with friends, 5 with a girlfriend or boyfriend, 4 with the doctor, and 6 spoke with no one. Of those who spoke to no one, 7 were controls, and the one trait was a 13 year old boy. There were no significant differences between the traits and controls.

When asked whether they were satisfied or dissatisfied with their understanding of thalassemia and thalassemia trait, 14 said they were, and 16 were not. There were no differences between the traits and controls on this question.

Response to Interview

For quite a few of the participants, the interview served as a reminder of information which they had stored. Several stated that they never thought about the trait until they had been called for this interview. Many said that they had become dissatisfied with their understanding of thalassemia as a result of the interview. All seemed interested and asked numerous questions after the interview. (See Appendix B)

One case serves to point up some important features of this age group. P.K. is a 19 year old female, freshman in college, who had been tested 3 years previously when she was 16 and in the 10th grade. Her aunt had died of Cooley's Anemia, and she demonstrated a very good understanding of both the trait and the disease. When asked how she felt when she was told that she had the trait: "At the time it didn't bother me. Everyone was telling me not to go out with Greeks or Italians. I didn't think it was serious, it isn't. If I do marry someone with the trait, I might not be able to have kids. I'll worry about that later." The impression from the interview was that her understanding and adjustment were excellent. However, the day following the interview she began thinking more about having the trait and became quite concerned. That night she called home to report that she had been interviewed and had enjoyed the interview, but now was becoming concerned. For the first time in her life she was dating seriously and marriage had become more tangible to her.

And for the first time she felt that her carrier status was pertinent--3 years after being tested.

Results of α Trait Interviews

Only three adolescents with α trait were interviewed. They were aged 16, 17, and 23 at the time of the interview. One was a male and two were female. All were single. Two spoke English at home, and one spoke Greek. All had a B grade average in school. In terms of demographic data, motivation to participate in the program, knowledge of thalassemia and thalassemia trait, they do not differ from the rest of the population surveyed. All had a fair-good understanding of thalassemia, and all had a fair-good understanding of the trait. Since, no valuable statistical analysis can be made on so small a group, only the results pertinent to α thalassemia trait will be reported.

All three α traits shared confusion about the difference between α and β thalassemia trait. None of them knew the difference between the two conditions, and their responses to the questions were indistinguishable from those with β trait. All felt that they had a condition associated with a mild anemia which should not be treated with iron. All felt some concern upon hearing their test results. And all felt the need to be careful choosing a marital partner, taking particular care in regard to childbearing. In one instance, the adolescent's family expressed some concern about their son's "problem."

These results will be presented as three case reports:

Case #1: S.M. is a 16 year old male, the son of first generation blue-collar parents. He was born in Greece, and Greek is spoken at home. When asked what α trait was he responded: "I've never heard of α or β thalassemia. All I know is it's not as dangerous as the disease. They told me not to tell the doctor, and that I shouldn't marry someone with the trait. They told us that if we marry someone with the trait, and we want to have kids, we've got to adopt. Also, you can't take iron, because your body's anemic to iron and something's going to go wrong. If I don't have the disease, and I don't marry someone with the trait, and I don't take iron, then I don't have anything to worry about. So that's what I'll do. I'm not worried." When asked how he felt when he was given the test results, he said "I was a little scared, because I didn't really know what to think. I thought I was in bad condition. As soon as they explained it, I wasn't worried any more. I figured there was nothing wrong. But my mother is afraid to find the truth. She doesn't want to know. She knows but doesn't want to believe it. She thinks

you have to be embarrassed about it. I'm not exactly proud of it, but I'm not embarrassed about it."

Case #2: K.M. is a 17 year old female, in the 11th grade. She is third generation American. She answered all the questions about β trait as if it were the trait she carried. "It is less severe than the disease. It can't harm me but I have to be careful whom I marry. Iron could kill me, it could be fatal. If I have too much, it would make me sick. That's why I have to eat a lot of raisins, because they are an iron supplement . . ." When asked what α thalassemia was, she responded: "That's what I have. I have no idea what either α or β are. They told me to be careful who I marry. β trait, I think, is worse. I don't worry about it. My mother told me that all I had to know was just not to marry someone with it too."

Case #3: B.S. is a 23 year old female laboratory technician, who is also third generation American. She was confused between α and β, major and minor. When asked what she was told she had, she said: "I think it's the major, I'm not sure. I

need a review program. If I do get married, I'll go through the program again to find out what my chances are of having a child with the disease. I started thinking about it seriously when I was dating an Italian and we were making plans to get married. I made him go get tested; I never found out the results, because we broke up." Her knowledge of thalassemia trait, in general, was fair. She knew it was a gene that could be passed on to offspring, but she was confused in one important way: "If only one parent has the trait then the child can get the disease too but the chance is not as great."

CHAPTER 5

Discussion

The response of the adolescent to mass genetic screening and education and the subsequent diagnosis of thalassemia trait has been examined for three major issues:

1) How well does the adolescent comprehend the factual information about thalassemia trait and thalassemia major?

2) What emotional impact does carrying the trait for a lethal disease have on the adolescent?

3) How does the adolescent incorporate his/her knowledge into marital and reproductive attitudes?

I. Education

Several conclusions drawn from genetic screening programs in adult populations have been explored in this study of adolescents. A major disappointment of genetic counselors in the past has been that recall of information is surprisingly low except in highly educated and highly motivated groups. Furthermore, an adequate background in human biology and genetics is mandatory for genetic information to be understood. Taken together, the perceived seriousness of the disease and the undesirability of the outcome constitute the emotional interpretation of the risk. These appear to affect one's ability to assimilate knowledge.

Recall of information

It is difficult to evaluate retrospectively previous

knowledge, but in view of the overall incidence of Cooley's Anemia and the minimal publicity it receives, it is not surprising that 70% of the adolescents interviewed recalled knowing nothing about it prior to the screening. Following the screening, 37% had a good grasp of the nature of the disease, and 43% had a fair understanding.

Most knew that it was a fatal, inherited disease affecting Mediterraneans, few understood the defect, symptoms, or treatment, and traits knew no more than the controls. Those who knew someone with the disease or recalled having known something about it prior to the screening did know significantly more than those who did not. Those tested three years ago knew somewhat more than those tested one year ago.

Several explanations for these differences can be postulated. We have seen that there is no association between knowledge of the disease and either hearing the original talk or reading the pamphlet. If little were taught in the original education program about the disease, then the information which these adolescents have about the disease has resulted primarily from other exposures. These might include personal acquaintances with those having the disease. This, however, would not explain the differences in knowledge of the groups tested one and three years ago, since those tested one year ago knew less about the disease but knew more people with Cooley's Anemia. One must explain why those screened a longer

time ago knew more about the disease. Leonard concluded that in relation to their children's diseases parents' knowledge correlated closely with their having heard of the disease before experiencing it.[27] And as Rosenstock has pointed out that knowledge is most valuable to the already knowledgeable,[31] those who already knew something about Cooley's Anemia had a stronger foundation on which to accumulate more information. Those who have been cognizant of thalassemia for a longer period of time would have had more opportunities to assimilate more information. And those who also knew someone with Cooley's Anemia would be more likely to pay greater attention once they had learned of the disease. If this is true, it would seem that one exposed to the concept of the disease earlier might accumulate more information than someone with a later exposure.

The understanding of thalassemia trait appears to be influenced by other factors. The whole test population had a greater overall knowledge of the trait than the disease: 50% had an excellent understanding, 30% had a fair understanding, and only 20% had a poor understanding. Most important to the understanding of the trait was 'having the trait' itself. No one with thalassemia trait had a poor understanding of the trait. Those with the trait were more likely to have a more realistic concept of the trait, to know the 'symptoms' of the trait, and to know not to take iron supplements. They were much less likely to confuse the trait with the disease itself. These findings may be attributable to differences in motiva-

tion, as many authors have identified this as a primary variable in the acquisition of knowledge.[31,60] As one participant aptly put it: "You don't pay attention till you have it." Those with the trait also received an additional counseling session when their results were reported by telephone. Many expressed having been confused about the trait prior to the phone call; therefore, this additional educational time appeared to be quite important.

Those with the trait also knew significantly more about the genetics of thalassemia than the controls, with 86% of them and 37% of the controls having a fair or good understanding. Most of the traits (93%) knew that both parents must have the trait for the children to inherit the disease; 86% of the traits knew that if two people with thalassemia trait marry, their children have a 25% chance of inheriting the disease. Therefore, it appears that comprehension is greatest for those for whom the information is most pertinent. Similar to the factors contributing to knowledge of the disease, those who knew someone with the trait or the disease also knew more; all 8 who did not know anyone with the trait had a poor understanding. Only in the knowledge of genetic risks did intelligence play a significant role, and those with higher grade averages were somewhat better at comprehension of genetic material.

Knowledge was not related to age in any way. The youngest age group comprehended the concepts and genetic

risks of thalassemia as well as the older age group.

Background in human biology

This adolescent age-group is unique with 87% having received courses pertaining to human biology and genetics. Only 43% had a good general knowledge of basic genetic principles, but almost all of them knew that brown-eyed parents could have blue-eyed children. Since this recessive pattern is similar to the inheritance pattern of thalassemia, one might postulate that utilization of this concept could be helpful in educating the adolescents about the genetics of thalassemia.

Once again, intelligence and education were significant factors in comprehension of genetics. Those adolescents with the trait who had more educated mothers and fathers and who spoke English only and those controls who had more education had a greater general genetic knowledge. And again, age appeared to be an irrelevant variable.

Many have shown that an adequate background in human biology and genetics is fundamental to the understanding and recall of information related to genetics. In contradistinction to the literature on genetic education, no association was found in this population between general genetic background and the knowledge of the genetics specific to thalassemia. It is apparent that most of the adolescents interviewed never made the intellectual connection between the genetics they had learned in school and the genetics of Cooley's Anemia. Many

who were theoretically familiar with dominant and recessive inheritance patterns did not know that Cooley's Anemia was a recessive trait. Genetic screening and education programs for adolescents should make a greater attempt to integrate the knowledge specific to the inherited disorder with that which has been taught in school.

Emotional interpretation of the risk

The emotional factors which contribute to one's understanding and retention of information related to genetic disease are difficult to define. We have seen that the comprehension and recall of information about thalassemia is not solely related to age or intelligence or basic genetic background. Other factors have appeared more important: whether one has the trait, whether one knows anyone with the trait, and whether one knows anyone with the disease. Therefore, their perceived susceptibility appears to play a significant role in their acquisition and retention of information.

Studies have shown that other factors may contribute to one's emotional interpretation of the risks.[33,61] Most important among these are the perceived seriousness of the disease and the undesirability of its outcome rather than merely the adequacy of education. And, indeed, the perceived seriousness of thalassemia trait does appear to correlate with factual recall. Those who both carried the trait and considered thalassemia trait more serious were more likely to have greater retention of information. But since this asso-

ciation did not hold for the controls, one must postulate an interaction between these two variables.

II. Emotional Impact of Carrying the Trait

The literature in clinical genetics is saturated with the fear of the psychological effects of labeling an individual as a carrier. Phrases such as "psychic burden" and "negative psychological impact" describe these effects, but a detailed explanation of these terms is lacking. Others have mentioned the "potentially greater psychologic problems and misunderstandings in teenagers" and the "considerable anxiety" found among those who learn that they are carriers. In contradistinction to these fears, the possibility does exist that adolescents, being both less formed in terms of self-concept and less threatened by immediate childbearing responsibilities than adults, might also be less traumatized by learning that they carry the trait for a lethal disease.

Initial response to test results

Less than half (43%) of the people who have the trait were upset at the time that they were told about it; most reported that they had forgotten much of the information they had been taught. Following their telephone "counseling session," however, most recalled having felt better and having stopped thinking about the results. Those females who were third generation American and spoke English only were more likely to be upset, though this finding may reflect a sample bias.

The responses of the controls might provide a better insight into the pre-existing anxieties of this group. Eleven (69%) of the controls reported feeling relieved upon receiving their results. This relief implies that an underlying fear was allayed.

Subsequent responses to test results

Those with the trait think about the results of screening more often than the controls. Seven traits and three controls reported thinking about them "occasionally" or "often"; three traits and seven controls "never" think about them. These thoughts are most often activated by a discussion of anemia or by overhearing a discussion of Cooley's Anemia; occasionally thoughts about dating and marriage bring the test results to mind.

Looking at the ways in which the traits and controls differed in response to some of the interview questions gives added insight into their defense processes. Notably, when asked why they had decided to participate in the screening program, most of those with the trait claimed to have been "made" or "forced" to by their parents, whereas most of the controls claimed to have been self-motivated. Since many of the traits and controls were siblings or relatives, it is unlikely that the motivation would be so different in the two groups. There were four sibling pairs in which one was a trait and the other a control: two of the pairs had discrepant reasons for participating. This discrepancy suggests

that those with the trait may tend to blame others for the discovery of their carrier status or may assign responsibility for this to those from whom they received the trait. The controls would not experience a similar need.

Several responses also indicated that denial might play a role in the reactions of those with the trait. As an example, it might be expected that those who had been anemic prior to the testing would be more motivated to participate in the screening program, but this correlation was not found.

Another interesting difference in response between the traits and controls is found in the perceived seriousness of thalassemia trait. Though most of the adolescents thought it was quite serious (more serious than mononucleosis, color blindness, broken leg, acne, and sprained ankle) those with the trait considered it less serious than the controls. No one with the trait thought it was 'very serious.' This may demonstrate some use of denial by those with the trait; a need to see their "affliction" as less serious than others see it. An equally possible explanation is that those with the trait are more knowledgeable about thalassemia trait and have a more realistic view of its seriousness. One might still be concerned that their perceived seriousness is greater than would be desired, because the trait is presumably a benign condition with practical importance only in future childbearing plans.

There was also a difference in the perceived seriousness of Cooley's Anemia between the traits and controls. Though

the controls felt that Cooley's Anemia was the most serious disease, the traits were more likely to consider the description of a disease similar to Cooley's Anemia as more serious. This view might also represent their desire to consider as less serious a disease about which they must be concerned.

Potential negative impact of the screening

Some unsuspected concerns were found among those who did not carry the trait. Even though they knew that they did not have the trait, four of the controls (25%) expressed some concern about having children. In addition almost all of the controls wanted both their mates and children tested for the trait. These findings may indicate some misunderstanding of the information about thalassemia trait, but other more powerful influences may also be acting. In particular, there appears to be a disbelief that the test results were accurate and several felt that they should be retested later.

The individuals with α trait all expressed undue concern regarding marriage and future childbearing. None were aware that their having α trait would have no bearing on the potential for disease among their children. For this reason, one might argue with the advisability of informing a population who need not change their reproductive plans.

III. Marital and Reproductive Attitudes

Studies of the reproductive outcome of genetic screening programs have demonstrated certain difficulties in changing

the attitudes and behavior of adults. Carriers of genetic traits have not appeared to change significantly either their mate selection behavior or their reproductive behavior in response to the knowledge they have received.[34] Though they may consider themselves susceptible, consider the possibility of conceiving an affected child extremely serious, and be motivated to prevent the birth of an affected child, they may yet be unable to take the "appropriate" preventive action. In a group of Greek American adolescents one might expect that in addition to ethical and religious beliefs, parental pressures might influence reproductive behavior. Since reproductive behavior cannot be studied directly in this population, an attempt will be made to define their beliefs as well as those factors which appear to influence the beliefs.

Greek Orthodox: ethical and religious beliefs

Traditionally the Greeks have had a conservative view toward marriage and family planning--tending to marry within the church, have larger than average families and to condemn those practices which might deny life to a child--abortion and birth control. Therefore, it is important to evaluate the status of those beliefs and their implication for future behavior in regard to genetic prevention in these adolescents.

Dating and marital behavior

Changes have occurred in the dating and marital behavior of Greek Americans in recent years. As the Greeks are

a minority in the U.S. it is not only unlikely that Greeks will only marry Greeks, but it is also not considered desirable by some of them. Some of the adolescents with living grandparents have said that their grandparents' wishes would be for them to marry someone Greek while others have expressed a desire to become more acculturated by marrying outside the Greek community. Some said emphatically: "I would never date a Greek boy!" Most consider the possibility real, but say: "I certainly do not go out of my way to date someone Greek." A few felt that: "There is about an 80% chance that I will marry someone Greek." Thus, the overall impression is that marriage within the community would be pleasing to the grandparents but did not hold the same priority it had in the past. In the last four years (1972-1976), 59 marriages were conducted in the Greek Orthodox church in New Haven: 8 marriages were between Greeks, 12 between Greeks and Italians, and 39 between Greeks and non-Mediterraneans.

What meaning might these changing dating and marital patterns have for the adolescent and young adult with thalassemia trait? Two with the trait felt that they should discontinue dating Greeks and Italians. Most deny that having the trait will affect their choice of mate; only one person with the trait thought it would. One of the married participants had considered her trait status in her marital plans. She has been quite worried when she received her test results, because she was dating an Italian at the time. She worried about getting married and having children. "Then I

more or less took it out of my mind. Then I married someone I didn't think would have it. I did consider it when I decided to get married. I'm glad I knew." Her parents appeared to be a motivating force behind her marrying outside the church: "My parents were concerned. I think my mother would feel guilty if I were to marry someone with the trait."

Therefore, some alteration of mating behavior may occur. In these instances, the parents may operate as a motivating influence rather than as a conservative and inhibiting one.

In addition, these adolescents express an interest in limiting their family sizes to a greater extent than their parents. They described a median family size of 2.5 compared to 3.0 for their parents.

Attitudes on family planning and abortion

In contrast to the traditional Greek Orthodox beliefs about family planning, these adolescents express a more liberal view. In those instances related to thalassemia, the support for family planning was particularly high. Among the potential reasons for supporting family planning, they were most likely to support the limiting of family size in the event that they 'already had a child with Cooley's Anemia' and when there was a 'chance of having a child with Cooley's Anemia.' The older females with the trait and those who were employed full-time showed the highest support for family planning in those instances related to thalassemia. It appears that for

those in whom both marriage and the decisions about family planning present more imminent possibilities, support for family planning is quite high. The youngest group of males and females also expressed a strong support for family planning. This might indicate greater attitudinal flexibility among the younger age group. Education and acculturation do not appear to play a role in these beliefs.

The whole group's support for abortion was somewhat less, but not substantially so. These adolescents were most likely to support abortion in the event that the pregnancy were a 'threat to the life of the mother.' This was followed by two circumstances related to thalassemia: 'in the event that a definite prenatal diagnosis of thalassemia were made' and 'in the event that there were a chance of having a child with Cooley's Anemia.' Those with the trait, for whom the decision might present a real issue, were more likely to support abortion for a 'chance of having a child with Cooley's Anemia.' And those with the trait who had a better understanding of the trait were most likely to support abortion in this instance.

The traditional Greek Orthodox views appear to play a larger role in the abortion issue than they do in family planning. All those born in Greece gave low support to abortion in all instances. However, as none of these were carriers of thalassemia trait, no conclusion can be made about the effect of carrying the trait on their abortion attitudes. Though

it is possible that having the trait might also affect their beliefs, those who study genetic screening of groups with strong religious affiliation must remember that a portion of the population may still hold some of the more conservative ethical tenets.

Potential barriers to change in reproductive behavior clearly exist among this population; but, in evaluating these adolescents, one must not view these barriers as being age-related.

CHAPTER 6

Recommendations for future screening programs

1. Age for individuals to be tested: Adolescence appears to be a favorable time for receiving genetic screening and counseling. Traits and controls alike thought that this age was a good one or even too late for testing. Only one felt that this age was too early. Most adolescents have received some human biology and genetic background in school and appear to be intellectually prepared to receive specific personal information. Their recall of information compares favorably with results of genetic counseling in the literature. It appears likely that the presentation of information to this age-group, rather than to adults, allows more time for assimilation and incorporation of the material before marital and reproductive decisions have to be made. Thus, adolescence may be the least anxiety-provoking time to introduce this information.

2. Educational program: As adolescents are being asked to make decisions which could prevent the birth of a child with thalassemia major, perhaps greater emphasis should be given to the description of the disease in the original program. In explaining the genetics of thalassemia, it would be advantageous to incorporate some of the genetic principles which participants have learned in school. For example, utilizing the recessive pattern of blue eyes might help clar-

ify and integrate the genetic information provided in the program.

3. Genetic counseling: The telephone call in which the test results were discussed appeared to provide invaluable information and support to those with the trait. Many had fears and confusions which were eliminated during this interview. In addition, the telephone conversation added some personal interaction which would not be provided in the original screening and education program. It is a relatively efficient and inexpensive method of providing genetic counseling requiring very little personnel. In addition, a telephone call directly to the adolescent is superior to utilizing the mail since it allows the results to be reported directly to the adolescent rather than to the parents.

4. Follow-up: For those with the trait and those controls who had some confusions, the follow-up interview provided by this study appeared to be very helpful. Following each interview, a great deal of time was spent in which the participants' questions were answered with description of the disease, the trait and its significance, and genetic risks. Several parents who were confused or upset also asked for information. Some form of follow-up resembling this could be continued in future programs. Perhaps this could take the form of an explanatory letter, but an additional discussion session for those who still had some questions would probably be more desirable and useful, as many expressed a desire to attend such a session.

5. Advisability of informing α traits: Unless a greater attempt is made to clarify the meaning of the α carrier status, more harm than good appears to result from this information. Judging by the confusion of those with the trait, it does not seem wise to include a description of α trait in the original education program at the risk of confusing the major issues being taught. Furthermore, since no reproductive decisions will be made based on the understanding and knowledge of α thalassemia trait, perhaps the extra time necessary to carry out a separate education program is not justifiable.

6. Community liaison: A prominent member of the Greek Orthodox church played a key role in organizing the original testing program, conducting the education and testing, informing participants of their test results and counseling them by telephone, and conducting the follow-up study. Being known to most of the participants, she added the necessary credibility and coherence to the program. Without such a model figure, similar programs have failed to command enough attention to be successful. Furthermore, a respected community member can dispel much of the distrust often engendered by the intervention of an alien organization. For these reasons, such a person might well be the most important variable in a single program. And, in future programs of this nature, a greater effort should be made by the organizing group to identify and utilize a known community member to act this essential liaison.

7. Utilizing adolescents or young adults to impart information: The participants in this program made several comments before and after the interviews conducted for this study that it was easier to share feelings and informational needs with someone their own age. Perhaps in addition to adult members of the medical profession, some use of peers could be tested in future programs.

APPENDIX A: INTERVIEW

Screening Program for Thalassemia

Date: _____

Length of interview: _____

time began: _____

time complete: _____

Name: _____ ___1

Age: _____ ___2

Sex: _____ ___3

Grade: _____(completed) ___4

Job: _____ ___5

Religion: Greek Orthodox _____ Catholic _____ Other _____ ___6

Marital status: _____ ___7

Children: #= _____ ___8

Ages: _____ ___9

Sibling #: _____ ___10

Sibling position: _____out of _____ ___11

Father's occupation: _____ ___12

education: none _____ grammar _____ high school _____ ___13

college _____ graduate school _____

Mother's occupation: _____ ___14

education: none _____ grammar _____ high school _____ ___15

college _____ graduate school _____

Grade point average in school:

A _____ B _____ C _____ D _____ ___16

1. Approximately how long ago did you participate in the program?

   3 years ____
   2 years ____
   1 year ____ ___17

   a. What grade were you in at the time? _____ ___18

   b. How old were you? _____ ___19

2. Can you tell me something about how you learned about the program?

   church news ____
   local news ____
   priest ____
   sibs ____
   friends ____
   parents ____
   other ___20

3. What made you decide to participate?

___self motivated? (curiosity,concern...)

___other-motivated?

When you were making your decision about whether to participate, did you discuss it with anyone?

yes ____ no ____ ___21

If so, with whom?

priest ___
parents ____
friends ____
other _____ ___22

What was their reaction?

encourage ____
discourage ___ ___23

4. What did the program in which you participated in include?

film _____ ___24

slide show ____ ___25

talk ____ ___26

pamphlet ____ ___27

Did you read the pamphlet? yes ____ no ____ ___28

Do you still have it? yes ____ no ____ ___29

additional counseling ____ ___30

How many times? _____ ___31

5. Had you ever heard of thalassemia (Cooley's anemia) before the screening program ____ years ago?

yes ____ no _____ ___32

If so, do you remember what you knew about it?

anemia ____ ___33

Greeks ____ ___34

genetic ____ ___35

fatal ____ ___36

Do you think you had any misconceptions? Did you believe certain things about thalassemia then that you no longer believe?

yes ____ no _____ ___37

If so, what were they?

6. Suppose you were asked to describe thalassemia major (Cooley's anemia) to someone who had never heard of it, what would you tell that person?

   a. What is the defect?
   b. How does one get it?
   c. Are some groups of people affected more that others by the disease? Which?
   d. What are the symptoms?
   e. What is the treatment?
   f. What is the life expectancy?
   g. What do you think it would be like to have Cooley's anemia?

7. What exactly is thalassemia minor (trait)?

   a. How does one get it?
   b. What are the symptoms?
   c. What is the treatment?
   d. How common do you think it is?

8. Are either males or females affected more frequently by Cooley's anemia?

yes ____ no _____

If so, which?

males ____ females _____

9. What is your impression of the method used to test for thalassemia trait?

10. Why is it important to diagnose thalassemia trait?

Are there any possible dangers of not knowing that one has thalassemia trait?

****Next, I shall give you several examples of couples in which one or both members have thalassemia trait and ask you some questions about their children.

11. Example:If neither the mother nor the father carried the gene for thalassemia, what chance would their children have of having thalassemia minor?
The answer would be: none.

Check:

What % is 1 out of 4? _____

What % is 1 out of 3? _____

What % is 1 out of 8? _____

What chance does 10% stand for? _____

What chance does 50% stand for? _____

12. If a woman with thal trait were to marry a man who did not have the trait, what percentage of their children would probably have thal trait?
What percentage of their children would probably have thal major (Cooley's anemia)?

13. If a woman with thal trait were to marry a man who did not have the trait, and the first three children were normal, what chance would the fourth child have of carrying the trait (having thal minor)?

14. If one member of the couple (in this case, the father) had thal trait, would it be possible for three children in a row to carry the trait?

15. If a man with thal trait were to marry a woman who did not have the trait what percentage of their children would probably have thal trait?
What percentage of their children would probably have thal major (Cooley's anemia)?

16. In this example, one parent (the mother) has thal trait.
If the first two children had thal trait, what chance would the third have of having thal trait?

17. If both parents carried the gene for thal (had thal minor), what percentage of their children would probably have thal trait?
What percentage would probably have thal major (Cooley's anemia)?
What percentage would carry no gene for thal (be normal)?

18. Both parents carry the gene for thal.
If their first child had thal major, what chance would their second have of having thal major?
What chance would the second child have of having thal minor (trait)?

11. Example: If neither the mother nor the father carried the gene for thalassemia, what chance would their children have of having thalassemia minor (trait)?

The answer would be : no chance.

Example

H indicates gene for normal hemoglobin

12. If a woman with thal trait were to marry a man who did not have the trait,
a) what percentage of their children would probably have thal trait?

b) What percentage of their children would probably have thal major (Cooley's anemia)?

Thalassemia trait _____%

Thalassemia major _____%

H indicates gene for normal hemoglobin

h indicates gene for thalassemia

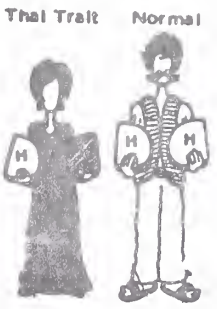
Thal Trait

?

Thal Major

?

13. If a woman with thal trait were to marry a man who did not have the trait, and the first three children were normal...
What chance would the fourth child have of carrying the trait (having thal minor)?



H indicates gene for normal hemoglobin

h indicates gene for thalassemia

?

What chance? _____

14. If one member of the couple (in this case, the father) had thal trait (minor)...
Would it be possible for three children in a row to carry the trait?

H indicates gene for normal hemoglobin

h indicates gene for thalassemia

Is this possible? yes _____

no

15. If a man with thal trait were to marry a woman who did not have the trait...
a) What percentage of their children would probably have thal trait?
b) What percentage of their children would probably have thal major (Cooley's)?

Thalassemia trait _____%

Thalassemia major _____%

H indicates gene for normal hemoglobin

h indicates gene for thalassemia

Thal Trait

?

Thal Major

?

16. In this example, one parent (the mother) has thal trait.
If the first two children had thal trait, what chance would the third have of having thal trait?

H indicates gene for normal hemoglobin

h indicates gene for thalassemia

Thal Trait

Thal Trait

?

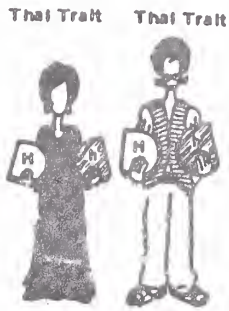
What chance? _____

7. If both parents carried the gene for thal (had thal minor),..

a) What percentage of their children would probably have thal trait?

b) What percentage would probably have thal major (Cooley's anemia)?

c) What percentage would carry no gene for thal (be normal)?



H indicates gene for normal hemoglobin

h indicates gene for thalassemia

? ? ?

Thalassemia trait _____%

Thalassemia major (Cooley's) _____%

Normal _____%

8. Both parents carry the gene for thalassemia.

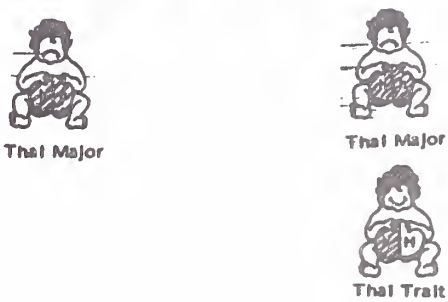
If their first child had thal major (Cooley's),

a) what chance would their second have of having thal major?

b) what chance would the second child have of having thal minor (trait)?

H indicates gene for normal hemoglobin

h indicates gene for thalassemia



? What chance? _____

? What chance? _____

***Now I shall ask you some questions about your reactions to the screening itself.

19. After you had learned about thalassemia trait, did you ever consider not being tested?

yes ___ no ___ ___

What doubts did you have about being tested?

none ___ some ___

Elaborate.

20. How did you learn the results of your test?

letter ___

phone ___ ___

parents ___

21. Can you remember what your reaction was when you learned the results of your screening?
(Did the results affect your feelings or mood?)

22. Do your parents know the results of your testing?

yes ___ no ___ ___

If so, how did they react to learning these results?

If not, do you feel it better that they not know? Why?

yes ___ no ___

25. Since September, how often have you thought about the results of your testing?

never ____
seldom ____
occasionally ____
often ____

What do you think about?

26. Have you ever wished you had not been tested?

yes ____ no ____

If so, what particularly bothers you about being tested?

27. How has the information you received in this program influenced your <u>future plans</u>?

Do you plan to get married some day? (or chose a mate)

yes ___ no ____

Would you like your mate to be tested for thal?

yes ____ no ___

Do you think you choice of a (husband/wife) will be influenced by whether or not (he/she) had thal trait?

yes ___ no ____

28. When you think about your future, do you think of having children?

yes ___ no ___ ___

Do you have any idea about how many children you might like to have?

2 ___
3 ___ ___
4 ___
more than 4 ___

Do you feel that there are reasons to avoid having children or to limit family size?

yes ___ no ___ ___

If so, how strongly do you support the following reasons for limiting family size:

	very strongly	strongly	slightly	not at all
	Total(trait/control)			
population explosion	7(5/2)	14(4/10)	7(4/3)	2(1/1)
financial difficulties	9(6/3)	15(6/9)	5(2/3)	1(0/1)
chance of having a child with thal major (Cooley's)	16(9/7)	7 (3/4)	6(2/4)	1(0/1)
having had a child with thal major (Cooley's)	20(11/9)	7 (2/5)	2(1/1)	1(0/1)

How justifiable is abortion to you in the following situations?

	very much	pretty much	somewhat	not at all
threat to the life of the mother	27(12/15)	2(2/0)	0	1(0/1)
unwed mother	8(2/6)	9(6/3)	4(3/1)	9(3/6)
unplanned child	4(1/3)	6(3/3)	7(4/3)	13(6/7)
chance of having a child with thal major	12(8/4)	6(4/2)	7(1/6)	5(1/4)
definite diagnosis of thal major in unborn child (if such a test could be done)	20(12/8)	4(1/3)	5(1/4)	1(0/1)

9. Listed below are a number of things which could happen to an individual. Try to score them as to whether you think they are: not at all serious, mildly serious, pretty much serious, very serious.

	Not at all serious Total (trait/control)	Mildly serious	Pretty much serious	Very serious
broken leg	4 (3/1)	20 (9/11)	3 (1/2)	3 (1/2)
acne	15 (8/7)	9 (3/6)	4 (2/2)	2 (1/1)
sprained ankle	16 (9/7)	12 (5/7)	2 (0/2)	0
appendicitis	1 (0/1)	10 (3/7)	16 (10/6)	3 (1/2)
thalassemia trait	1 (1/0)	12 (7/5)	12 (6/6)	5 (0/5)
heart disease	0	1 (0/1)	7 (4/3)	22 (10/12)
mononucleosis	3 (1/2)	9 (5/4)	13 (6/7)	5 (2/3)
color blindness	10 (6/4)	8 (2/6)	6 (2/4)	6 (4/2)

10. Certainly you would not want a close relative to have any disease. Of the following diseases, try to rank them according to which you would <u>least</u> like to have in your family.

a. being blind but otherwise normal

b. being confined to a wheelchair but otherwise normal

c. having a childhood disease that causes frequent hospitalizations and discomfort, but no physical or mental impairment and led to an early death.

d. Cooley's anemia

e. having asthma

1. (least like) _____
2. _____
3. _____
4. _____
5. (like most) _____

31. Listed below are a number of events which could happen to an individual. Please put checkmarks in the columns to the right of the item, according to whether the individual event is one which you would like very much, pretty much, somewhat, not too much, or not at all.

EVENT	I WOULD LIKE THIS:				
	Very much	Pretty much	Somewhat	Not too much	Not at all
having no cavities					
being 4 feet 10 inches tall					
having thalassemia trait					
not needing to wear glasses					
having clear skin					
not having thalassemia trait					
having one leg in a cast for a month					
being hospitalized for a minor operation					

****Now I would like to ask you just a few questions about thalassemia screening programs in general.

32. At what age do you think people might best be offered programs like the one in which you participated?

elementary ____
junior high ____
high school ____
college ____ ___
later ____

Do you think that your age was a good age for a program like this?

yes ___ too early ____ too late ____ ___

33. Should people found to have trait be counselled before marriage or after?

before ___ after _____ ___

34. Do you think it important for your own children to be tested through such a program?

yes ____ no ____ ___

If no, why not?

35. Would you recommend this kind of program to a friend of yours?

yes ____ no ____ ___

36. Do you have any other thoughts about this kind of program which might help improve it in any way?

37. Are you satisfied or dissatisfied with your understanding of thalassemia?

satisfied ____ dissatisfied ____ ___

Why?

****I would like to ask a few more questions about your health and the rest of of your family's.'

38. Construct a family tree to show ages and sex of the members of your close family, indicating whether any have thalassemia trait or major.

39. Do you know anyone else with thalassemia trait or thalassemia (Cooley's) within the extended family or among friends?

Family: _____

_____

_____

Friends:

_____

_____

40. Prior to the screening program, have you ever been thought to have a blood disorder?

yes _____ no _____ ___

If so, were you treated for it? With what and how long?

yes _____ no _____ ___

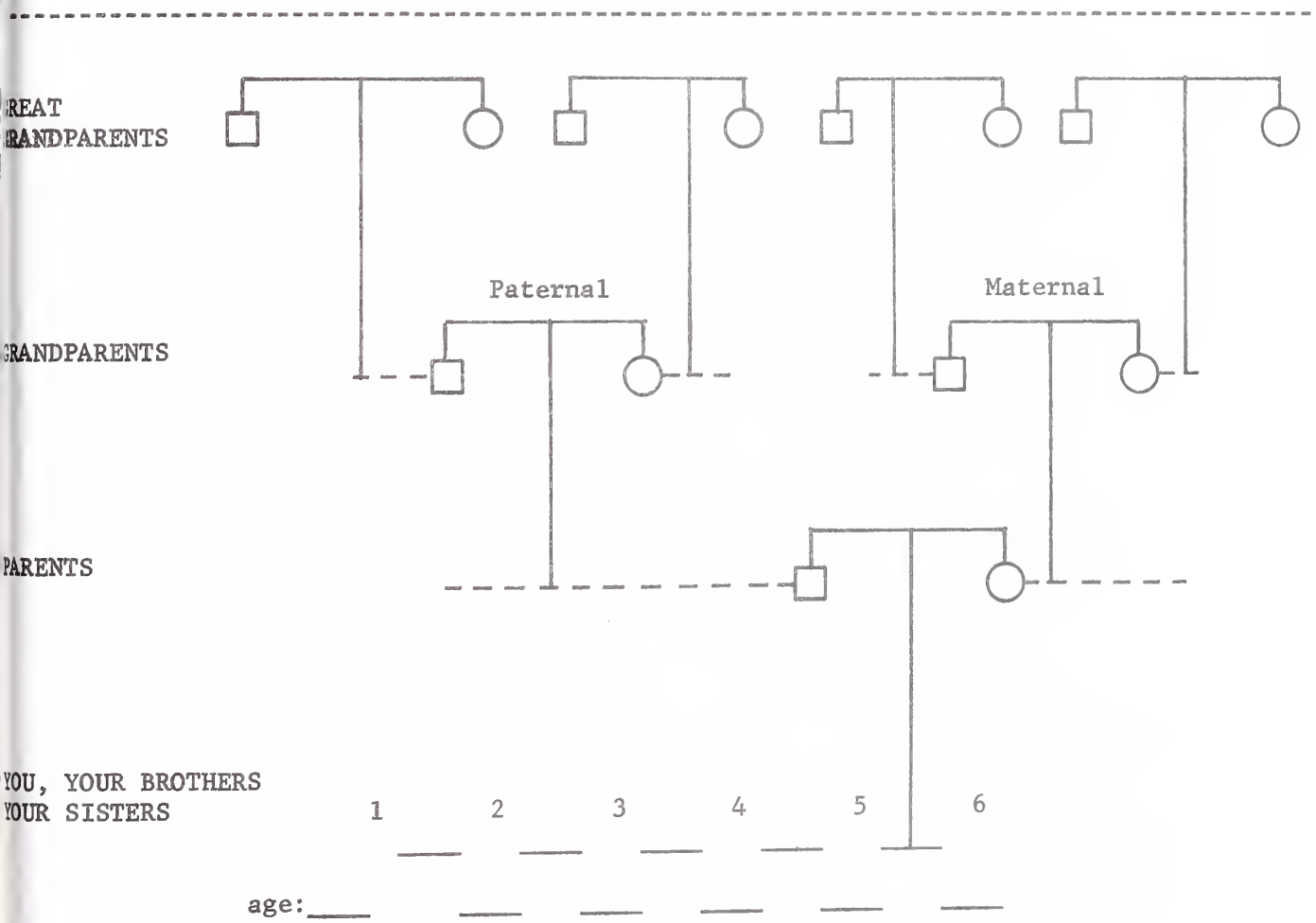
Treatment: _____ ___

Length of time: _____ ___

FAMILY TREE

Code: □ = male, no trait ◪ = male, thalassemia trait

○ = female, no trait ◔ = female, thalassemia trait



Interviewer's Assessment

1. Memory of the screening program:

   clear ____ moderate ___ vague ____

2. Understanding of thalassemia and inheritance:

   had only a general notion ___
   understood the concepts ___
   guessed ___

3. Interest in
   a)interview

   strong ___ moderate ____ slight ___ none ___

   b)thalassemia

   strong ___ moderate ___ slight ___ none ___

   c)time spent in post-interview informal discussion

   _____minutes

4. Intelligence (grammar, scientific grasp,ability to understand questions)

5) Were there any questions particularly difficult for the adolescent to answer?

6) Concepts which the adolescent did not grasp:

APPENDIX B: Questions Asked after the Interview

β Traits

Case #1: Why is there an anemia?
Why can't the body accept iron?
What is the life of someone with Cooley's Anemia like? What things do they think about?

Case #2: Why can't you take iron?
What shouldn't you do if you have the trait?
What effect will having the trait have on my muscles?

Case #3: I really don't know anything about the disease. Is it fatal? Is it really serious?

Case #4: What overall is the disease about?
How is it caused?

Case #5: What exactly is Cooley's Anemia? What is the life expectancy?
Isn't it more common in Greece than in the United States?

Case #6: I know I'm not supposed to have iron, yet my iron count is low, and I don't understand that.
What exactly is thalassemia major, the disease, the treatment, the life expectancy?

Case #7: What is the trait as far as iron is concerned?
What is the trait--what do you have to watch out for?
What is the life expectancy of the disease?
How exactly is the trait passed on?
If my husband's parents had the trait, could he pass it on to our kids?

Case #8: I would like to know exactly what the disease is.

Case #9: no questions

Case #10: What is a recessive?

Case #11: What is the difference between Cooley's Anemia and Mediterranean Anemia?
Can the trait become the disease?

Case #12: What is the difference between major and minor?
What are the effects when two minors mate?
I would like to know more overall about the disease and the trait.

Case #13: How will the trait affect my children?
How should it affect me? I think it affects me more mentally than physically, worrying about my future, children, and marriage.

Case #14: I would like to know more details about the disease.

∝ Traits

Case #15: I don't know what my blood is missing. I know it's anemic, but I don't know what anemia is--probably iron?

Case #16: What is Cooley's Anemia besides a blood disease?

Case #17: I don't remember much of what we were told before. I don't know my risk--whether it's high enough to prevent me from having kids.

Controls

Case #19: I feel I should know more--exactly what the disease does.
How disabling is it? I remember it was disabling, but not anything specific.
What exactly is the defect? What are the complications?
What is the financial burden to the parents?
Would the child die if he didn't get transfusions?
Can you let the child die?

Case #20: What is the treatment, the symptoms, life expectancy of the disease?
How can it be passed on? What exactly is the trait anyway?
What are your limitations, if any, if you have the disease?

Case #21: I would like to know more about what exactly is being done--what research steps are being taken?

Case #22: I don't really understand the difference between the trait and the disease.

Case #23: What happens to you if you get Cooley's Anemia?
What can you do about it?
What is the trait, and what can you do about that?

Case #24: What is the origin of the disease?
What is the process by which it is passed on?
Explain the probability part.
What is the treatment of the disease--what is the disease itself?

Case #25: no questions

Case #26: I don't need to know anything more unless my wife turns out to have it, and I'll wait and see then.
Are the red blood cells deformed, like sickle cell?

Case #27: no questions

Case #28: If I knew someone with Cooley's I would try and find out more, but now I have no questions.

Case #29: If I didn't have it once, I could have it again, couldn't I?
So you have to have another test again because you could get it.
If you have it, will your kids have it? I thought if the father had it, the kid would definitely have it. If the mother had it, the kid might have it. Is that right?

Case #30: How does the trait affect someone?
If someone does have Cooley's what is the treatment and the life expectancy?
If both parents don't have it, could the children have it?
What causes it--the trait? Why do people get it? Can you prevent from getting it, aside from not having children?
Is there a cure for Cooley's?
Is there anything they can do with the trait to prevent it from harming the person with it and the children?
Does it matter if someone is from the native land? Do they have a higher chance of having the trait?

Case #31: How is the trait passed on?
If my wife did not have it, could my child get it or not?
Does everyone with Cooley's Anemia die?

Case #32: I need to know some general knowledge about Cooley's Anemia so that you could detect it if you had it in case you didn't have a chance to be screened.
What are the symptoms of the disease?
If you're tested once and you don't have it, is there a chance you could get it later in life?

Case #33: Cooley's Anemia: what are the symptoms, how do you get it, can you cure it?
If you have the trait, what are the chances of your wife or kids getting it?

Case #34: I can't remember what happens if neither parent has it.

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